MnTAP

SOLUTIONS

MnTAP Intern Program 2016

MnTAP thanks our generous partners who make this vital work possible. Each of these organizations contributed financially to support at least one intern project for 2016. Their support helps MnTAP increase the number of intern positions available each year and helps maintain our continuing pollution prevention, energy efficiency and water conservation work.

"One of the most valuable things about the program is that interns will take the skills they learn here and use them in manufacturing and other organizations across Minnesota and the country for the next 20-30 years."
~ Mark Snyder, Pollution Prevention Specialist, Minnesota Pollution Control Agency

"We've seen some great energy projects come out of the Intern Program. We hope to continue our relationship with MnTAP for many years to come."
~ Lori Nielsen, Program Manager, Xcel Energy

Xcel Energy®
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METROPOLITAN COUNCIL

"It's wonderful to see the water savings that industries are obtaining through the expertise of the MnTAP interns."
~ Brian Davis, Senior Engineer, Metropolitan Council Environmental Services

" I believe the entire effort created a great deal of goodwill and the client was very pleased with the result. We are now starting to talk about other projects, and I believe the engineering study MnTAP created played a role in moving these projects forward."
~ Timothy Doherty, Business Account Executive, Dakota Electric

DAKOTA ELECTRIC ASSOCIATION
Your Touchstone Energy® Partner

CenterPoint® Energy

"The program not only provides our customers with additional resources to uncover energy saving conservation measures, it also provides tangible experience for young people who are the future of our industry. I'm amazed at the great work and significant projects that the MnTAP interns provide to our customers each year!"
~Todd H. Berreman, Director of Energy Efficiency, CenterPoint Energy

"One of the most effective things about the Intern Program is the interns and their professional supervisors can look at research projects we wouldn't have been able to tackle otherwise."
~Tim Gallagher, *Supervisor of Program Implementation, Minnesota Power*

minnesota power

CHEMICAL COATERS ASSOCIATION INTERNATIONAL

"It's tremendous to have real-world data we can now share with our membership on how they can implement cost-saving ideas that were discovered through the MnTAP Intern Program."
~Tim Milner, Owner, JIT Powder Coating and Board of Directors Member, Chemical Coaters Association – Twin Cities

“The MnTAP intern exceeded our expectations. He worked closely with employees learning the processes, professionally interacted with vendors and delivered cost savings.”

~ Bette Danielson, Safety and Environmental Affairs Manager, Nordic Ware

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The MnTAP Intern Program is coordinated by Paul Pagel; Linda Maleitzke is the program administrator. *Solutions* is designed and edited by Monique Dubos.

Director's Note

Health and Prosperity for Minnesota

Laura Babcock
MnTAP Director

Every year I marvel at how the MnTAP Intern Program continues to grow in scope and impact through the efforts of dedicated host companies, partners, student interns and MnTAP staff members. We know the host company staff are busy keeping their production going and their companies moving forward. Thank you for going above and beyond to support the students who carried out these projects.

A special call out to our sponsoring partners who help MnTAP support students in projects like the ones you will read about in this issue of *Solutions*. This support allows MnTAP to provide career development opportunities for students as well as reduce environmental impacts and improve the economic performance of businesses across the state.

The stars of this story are the creative MnTAP interns who spent their summer analyzing processes as diverse as improving efficiency of industrial coating lines, optimizing the use of water, and seeking ways to maximize the energy efficiency of compressed air, refrigeration, ventilation systems and a lot more.

In 2016, we explored ways to bring the value of a MnTAP intern to companies that might not be able to support a whole summer of activity by having some student interns spread their time and efforts across several smaller companies. As a result, 14 interns were deployed to reduce unnecessary inputs, decrease waste outputs and improve operating costs at 20 Minnesota businesses.

As you can see from the table below and the case studies that follow, the interns have provided another impressive year of accomplishments which represent a significant contribution to preserving the health of Minnesotans, maintaining the high quality of natural resources we enjoy and improving the economic prosperity of businesses throughout the state.

We hope you see how these solutions might apply to your business or the businesses you serve. Have a project that needs attention? Apply now to be a part of the 2017 MnTAP Intern Program. Find details on page 37.

"Having a MnTAP intern allowed the program to look in greater detail at a variety of issues that we normally have to by-pass due to time considerations, and our intern found energy savings opportunities every time."

~Christopher Plum, Operations and Contracts Manager, Center for Energy and Environment

2016 Intern-Proposed Solutions

Recommendation	Reduction	Cost Savings	Equivalents (annual)
Water conservation	173,840,000 gallons	$373,000	Water for 8,500 Minneapolis residents
Waste	2,273,000 lbs	$718,000	Weight of approx. 23 Metro Transit light rail cars
Energy	3,526,000 kWh	$459,000	Electricity for 367 Minnesota homes
Energy	145,000 therms	$93,000	CO_2 emissions from 162 passenger vehicles
Production Gains	---	$420,000	---
Total Potential Cost Savings	---	**$2,063,000**	---

MnTAP Intern Program

A History of Success

For over 30 years, MnTAP has been coordinating an intern program that places highly qualified students in facilities for up to three months to facilitate implementation of pollution prevention and energy efficiency solutions. The goal of the program is to provide benefits to companies and students while building MnTAP's knowledge base and extending our services to businesses around the state.

Interns Have Far-Reaching Impact

The impact of intern projects has reached far beyond the walls of host facilities; many of the solutions identified during the projects can be applied to other companies, which magnifies the impact of the program. From Thief River Falls and International Falls in the north to Albert Lea, Preston, and Jackson in the south, MnTAP intern projects have stretched across Minnesota. In fact, MnTAP interns have worked in facilities in 96 communities; over 60% of those facilities are in Greater Minnesota, while the other 40% are in the Twin Cities Metro Area.

Companies Reap Rewards

More than 240 companies have been served by the MnTAP Intern Program over the past 31 years. Interns have worked with companies as small as 12 employees and as large as 1,000+ employees in industries such as hospitality, healthcare, manufacturing, and food processing. Since 1985, intern recommended solutions have saved Minnesota companies 185 million gallons of water, 31 million kWh, 3.2 million therms, 109 million pounds of waste, and 10.5 million dollars annually!

Participating companies have proven to be committed to making changes. Through follow-up over the course of two years, MnTAP staff encourage and support intern companies to implement recommendations.

Summer 2016 interns

Students See Success

The MnTAP intern program is very popular with students as well. In 2016, 197 students applied to the program to fill the 14 summer internship positions. In total, 234 students have gained experience through a MnTAP internship over the past 31 years.

Interns have represented 27 different majors and more than 23 colleges and universities. Chemical engineering and mechanical engineering are the most common majors, and the majority of interns have been students at the University of Minnesota Twin Cities and the University of Minnesota Duluth.

The bottom line is, no matter the industry or the background of our interns, MnTAP intern projects result in solutions that positively impact a business' bottom line and reduce its environmental footprint.

Company Testimonials

"We are very pleased with the opportunity to exercise the intern's enthusiasm for soil & water sciences in a manner that promotes his education and our mission of excellence."

~ Douglas Bonar, Supervisor of Sites & Grounds, Anoka Hennepin Independent School District

"In a work environment in which one is pulled in many directions and needs to constantly reprioritize, it is refreshing to have an intern that can focus in on an issue that needs attention."

~ Patrick Bergin, Environmental Manager, Cemstone

"The hard work the student has put in over the past months is reflected in the success of the project and the quality of data being generated. His efforts and results will have substantial positive impact on the City of Woodbury's water efficiency efforts for years to come."

~Jim Westerman, Utilities Superintendent, City of Woodbury

"Working with MnTAP has been very beneficial to our company. Many assumptions were shown to be untrue and paved the way for us to improve, become a better company and steward to the environment."

~ David Mack, Environmental Health & Safety Manager, R&D Systems

"MnTAP's intern program has provided IBM's Rochester facility with effective, cost-advantaged solutions for energy consumption and associated waste streams in our site's centralized HVAC system. The intern was prepared, engaged, and delivered on the project requirements with minimal supervision."

~ Brian Morgan, Site Mechanical Engineer, IBM Rochester

"Having a MnTAP intern has allow us to provide an in depth technical assistance resource to multiple businesses. The intern project has served as a catalyst for innovative waste material reuse that will have many neighborhood co-benefits."

~ Jodi Slick, CEO, Ecolibrium3

"Our intern gave the St. Peter wastewater staff a fresh set of eyes and insight of our current energy consumption. Thanks to the data collection our intern compiled over the summer, we have developed a base line to measure our approach in evaluating our focus in reducing the plants energy consumption."

~ Jeff Knutson, Plant Superintendent, City of Saint Peter WWTP

MnTAP thanks the companies that hosted an intern project in 2016.

We recognize student success is directly related to company support!

Anoka-Hennepin Independent School District

Tanner Glaza
Bioproducts and Biosystems Engineering
University of Minnesota Twin Cities

Company Background

Anoka Hennepin Independent School District was founded in 1952 and served around 4,000 students at that time. Through the years, the district has expanded to encompass 172 square miles. Home to 24 elementary schools, 6 middle schools, and 5 high schools, the Anoka-Hennepin district is now the state's largest school district and provides a quality education to roughly 38,000 students.

ANOKA-HENNEPIN SCHOOLS
A future without limit

"Engineering is the tool that allows me to pursue my life-long passion of leaving the world better than how I found it. My future will benefit greatly from having learned how to develop, perform, and analyze logistically and financially efficient experiments and solutions that promote environmental health and conservation." ~ TG

Project Background

Anoka-Hennepin's 35 school properties use a combination of municipal and well supply water to irrigate approximately 243 acres of landscape (as of 2015), including 125 athletic fields. Athletic fields are spray irrigated by a variety of condition-controlled systems using rotary spray heads configured in zones. Different soil conditions affect the effectiveness of the watering plan.

The goal of the project was to analyze and prioritize water conservation opportunities at school properties and fields, collect data, conduct turf grass health assessments, develop watering protocols, and generate recommendations to improve turf safety while also reducing water use. Another aim was to help with mapping and documenting irrigation locations.

Incentives to Change

Anoka-Hennepin has an irrigation conservation goal of reducing irrigation water by 20% over five years. Currently, the district uses over 106 million gallons of water annually to irrigate 23 schools and maintain healthy turf at its athletic fields used for sports such as softball, football, baseball, lacrosse, and soccer, along with many other events. The district has dramatically reduced its water usage over the past several years through the implementation of rain and soil moisture sensors; however, there are opportunities for further reduction. The majority of turf watering is done between May and September, and roughly 21 inches of water is required to supply an average of one inch per week to the turf over this time frame. With an average of about nine inches of rain during the growing season, the district currently has to add about one foot of water to all of their fields to meet their average benchmark of one inch of water per week.

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Reduce Watering of General Use Areas by Half

The district has 352,380 square feet of irrigated turf that has been identified as general use turf. The use of each field varies from site to site. On some sites, there is turf that is irrigated, but is never used for high-profile events such as sporting competitions. Some examples include fields at elementary schools or green spaces that are out of public view. There are also many sites in the district that sustain green turf all summer long without being irrigated at all. By comparing the hydraulic conductivity (how easily water passes through the soil) of sites that are not irrigated to that of general use areas of irrigated sites, areas with potential for improvement were identified. These are areas that could sustain turf with less water. By reducing the water to these areas by half, there would be an average reduction of 1,318,000 gallons of water per year which translates to $23 in cost savings per year.

Eliminate Water Added to General Use Areas

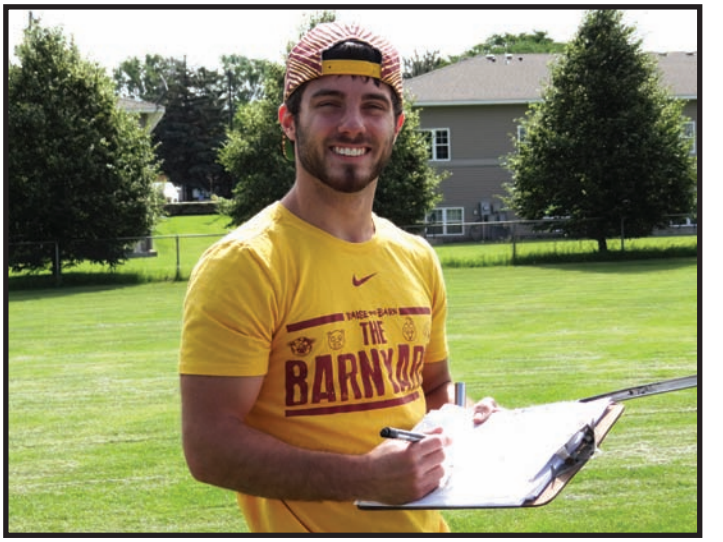
This is a tentative recommendation contingent on the results of the initial recommendation to reduce watering of general use areas by half. After the initial 50% reduction has been implemented and its impact has been observed and analyzed, the district could then decide to eliminate watering of the general use sites entirely. Since the soil conditions of the selected areas are comparable to those of sites that are not irrigated, this change is thought to be feasible. Eliminating watering of these areas would save an additional 1,318,000 gallons of water per year, resulting in $45 saved annually.

Reduce Water to Over-Watered Areas

In total, 414,720 square feet of turf has been identified as over-watered. This is because the soil drains water slowly and the roots of the turf have not needed to expand deep into the soil due to the abundance of water. It is recommended that the district reduce the amount of water supplied to these fields so that the turf can establish deeper roots and water usage can be optimized. Due to time and material limitations, the exact water demand of the turf was not determined, but recommendations and corresponding savings were provided in increments. The most conservative change is a 5% water reduction, which results in a savings of 155,000 gallons per year.

Aerate Champlin Park Baseball Field/Install Moisture Sensor

Champlin Park High School's baseball field is about 142,540 square feet. The field was determined to be over-watered because it has very low water infiltration and shallow turf roots. The Champlin Park football field, which is directly next to the baseball field, has been deep-aerated, and its infiltration rate is now over forty times better than that of the baseball field. It is recommended that the district aerate the baseball field so that it drains water similarly to the football field. After aeration, it is



recommended that moisture sensors be installed in the baseball and football fields, so that watering will stop once fields receive the proper amount of water. Research done by the manufacturer shows an average water savings of 40%, which equates to 745,000 gallons and $13 saved annually.

Recommendation	Annual Reduction (Gal)	Annual Savings*	Status
Reduce watering of general use areas by half	1,318,000	$23	Recommended
Eliminate watering of general use areas	2,636,000	$45	Tentatively recommended
Reduce water to over-watered areas (5% reduction)	155,000	$3	Recommended
Aerate champlin park baseball field/install moisture sensor	745,000	$13	Planned/recommended

*Annual savings come from avoided water costs from Anoka-Hennepin's well-water sources. Does not include potential electric savings from water pumping.

Cemstone

Brent Vizanko
Chemical Engineering
University of Minnesota Twin Cities

Company Background

Cemstone Products Company is a ready mixed concrete producer with 43 plants in Minnesota and a total of 57 plants in Minnesota, Iowa and Wisconsin. Many of their largest plants are located in the Twin Cities Metro as is their corporate headquarters, which is in Mendota Heights. Cemstone employs about 600 people, a majority of which are ready-mix truck drivers who deliver concrete to customers. The concrete that Cemstone produces is used to build large commercial buildings such as U.S. Bank Stadium as well as residential walls and driveways.

"Through my internship at Cemstone, I have been able to use my passion for water conservation to find and implement large water savings not typically seen in a residential capacity, further opening my eyes to industrial water use. I now feel fully equipped to make an informed decision on where I would like to work and what jobs fit my specific skill set." ~ BV

Project Background

Cemstone uses water from both private wells and municipal sources depending, on the plant. This water is used in new concrete production, truck rinse down, truck wash out, and saddle tank filling. Cemstone has also built 14 weir systems, which collect surface and rinse water, at their ready-mixed concrete facilities which make it possible to reuse the water used to wash out truck drums. The weir systems also clarify the water so that it can be used in the production of new concrete. Through this project, the company wanted to learn more about how water could be best conserved and reused in their process.

Incentives To Change

Cemstone prides itself on being an environmentally friendly company. Of the 12 plants studied, the average plant uses 4,720,000 gallons of water a year with 47% used in new concrete. By using less water, Cemstone will reduce their water and electricity bills. Another incentive for change is the National Ready Mixed Concrete Association's (NRMCA) Sustainability certification. By earning enough points, awarded for specific environmental practices like water reduction, a ready mixed concrete plant can be certified through the NRMCA. This would put Cemstone in a group of only four companies with a certified plant. Many of the plants that Cemstone operates are within five points of being certified, and reducing water usage will help them reach this goal.

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Install Automatic Shut-off Nozzle for Tank Filling

The truck saddle tanks are topped off before each concrete delivery. During this process, hoses overflow while drivers prepare their trucks for loading, spilling 4,390,000 gallons of water per year. Installing automatic shut-off nozzles would stop the flow of water when the tank is full, similar to a gas nozzle. This option is recommended for all 12 plants since it is easy to install and has the potential to save 7.7% of overall freshwater use.

Reuse Weir Water

Of the total water used in concrete production, only 4% is recycled weir water. All concrete process water must

comply with ASTM C1602 standards in order to be used in fresh concrete production and the weir water at each plant is well within these limits. Thus, footing mixtures could use 100% clarified weir water and remaining mixes could expand their usage to 50% clarified weir water.

The water in the basins of the weir system is first used for washing out the truck drums and has a pH of between 9-13 as well as suspended solids, which makes it usable only in the production of new concrete. The pH is too high for use in truck rinse down or saddle tank filling. Adding a CO_2 bubbling system to the final bay of the weir system would lower the pH of the water. This would also precipitate out the dissolved solids in the water, which would make the water more usable in hoses and pumps. This option is recommended for plants that do not need a Load and Go system, since this system is cheaper and would provide the same water savings.

The only two sites with a fully enclosed weir system are Burnsville and Minneapolis. The benefit of enclosing the weir system at other sites is the ability to recycle truck wash out water in the winter months. This is recommended at all sites that have a winter water usage of 500,000 gallons or more.

Install Load and Go Wash Systems

Cemstone is currently using 6,430,000 gallons of water annually for rinsing trucks after they are loaded is. A 2,700,000 gallon savings could be realized with a Load and Go Wash System installed at 6 of the 12 plants. The Load and Go system is a high pressure wash system that cleans the truck in 30 seconds as opposed to the average 4 minutes for manual washing. This not only saves water, it also saves time and prevents injuries.

Uniform Driver Training

There is a large discrepancy in how drivers use water, prompting the recommendation of a more uniform training regime. The training should include a portion on water conservation and how to appropriately use the weir systems, the saddle tank, and all hoses at the plant.

Collect Rainwater

The roof area of many of the plants exceeds 5,700 ft^2 which could collect more than 1,000 gallons of water in an average rainfall event. Rainwater is nearly potable and could be used in any application without filtration other than for drinking water. This would be advantageous for dust suppression, saddle tank filling, and cooling the aggregate piles in the summer and is recommended for sites with roof areas of 5,700 ft2 or greater.

Recommendation	Annual Reduction	Annual Savings	Status
Install automatic shut-off nozzles	4,390,000 gallons	$6,700	Being tested
Reuse weir water	7,570,000 gallons	$13,900	Partially Implemented
Install load and go wash systems	2,750,000 gallons 5900 hours	$301,942	Recommended
Uniform driver training	780,000 gallons	Variable	Partially implemented
Collect rainwater for reuse	910,000 gallons	Not known	Researching

Center for Energy and Environment

Tiger Rost
Aerospace Engineering
University of Minnesota Twin Cities

Organization Background

The Center for Energy and Environment (CEE) is a non-profit 501(c)(3) organization that works to promote the responsible and efficient use of natural and economic resources. CEE accomplishes this mission through research, program development, delivery and evaluation, financing and public policy initiatives. Often, small customers are left out of utility energy programs because they cannot afford to participate. Energy Intelligence is a no-cost service offered by CEE that gives small businesses the opportunity to participate in an energy efficiency program .

cee
Center for Energy and Environment

"I've always wanted to learn how everything works in a business, but with my regular job duties and routines, I never really had time to explore all the opportunities that were hiding in plain sight. It was refreshing to have an internship dedicated to finding just that - opportunities – and with them, knowledge of energy savings that can be applied to practically every engineering workplace." ~ TR

Project Background

CEE's Energy Intelligence (EI) program works with small businesses to help them save energy. The program is no-cost to businesses and funded through Xcel Energy, which builds the cost of the program into its utility rates. Xcel is required by law to set aside a portion of its budget for rebate and energy-saving programs, and MnTAP partnering with CEE was a great way to help companies find the opportunities and the rebates they have effectively been paying for all along.

The focus of EI is to identify energy savings that can be achieved through operational and behavioral changes, matching energy use with production activities. Businesses can take advantage of rebates through Xcel Energy and be introduced to technologies they might not have had time to consider. EI usually finds around 8% energy savings for each of the businesses they assist by using interval meter data. Interval data works by recording the pulse/smart meter data of each business and showing the consumption and kW draws in 15-minute intervals. This data allows EI to find opportunities in baseloads and peak periods. By combining this approach with an intern in the field, EI was able to find unique opportunities at each business that they might not have been able to identify without the extra set of eyes and hands.

Incentives To Change

By looking at more specific ways of saving energy at each company, the intern found that companies could save up to 30-40% of their total annual energy bill by implementing identified solutions. Over the course of the project, it became apparent that with experience the amount of time the intern spent at each site can be reduced – and savings per unit of time spent increased dramatically. Since the EI program is renewed with Xcel based upon results and energy saved, working with student interns can help sustain and perhaps even help expand the program by increasing its effectiveness.

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Project Approach

Part 1: Initial Walkthroughs

At each site, an initial walkthrough was conducted with energy management staff to identify work patterns and where the company uses energy. From this initial walkthrough, a list of possible opportunities were identified for the intern to explore and identify feasibility and viable savings.

Part 2: Gathering Information

After the initial walkthrough, the intern gathered more in-depth information including lighting counts, fixture identification, compressor loading and unloading, wattage and cycling times. Consulting with employees who have first-hand knowledge of the machinery and equipment was helpful in identifying patterns and possible opportunities. Research was also conducted on tailored savings opportunities, such as UV-LED curing, electroplate bath covering and injection mold sweat prevention. Throughout the process, vendors were contacted and re-contacted as needed.

Part 3: Writing and Presenting Reports

After gathering all information, the intern synthesized it in a report and calculated the financial savings, cost, payback, and energy savings. The goal was to identify opportunities with a short payback by minimizing costs and maximizing energy reduction. Some things, such compressed air leaks, can be fixed with very little cost. Others, such as dehumidification or UV-LED curing, have large upfront costs but proportionally large future energy savings. After the reports were finalized, they were presented to the company for implementation decisions.

Summary of Assessments

Five energy audits were conducted at companies in industries including printing, electroplating, constuction, injection molding, and millworking. While there were many different industries, there was often cross-over in major opportunities, such as lighting and compressed air. Often, sites can switch from 32 W fluorescents to 25 W of the same variety – or even use 15 W LED screw-in bulbs that are compatible with the existing fixtures. There were some restrictions on light levels, but all sites in this study have over-lit shop areas, meaning there is a potential for de-lamping, reducing fixture counts, and adopting task lighting as needed. As for compressed air, four of the five sites in this project had significant leaks. Since compressed air is ten times more expensive than electric energy, compressed air savings in any form are significant. In addition to addressing leaks, sites can often turn down their air pressure set-point levels to save a portion of the compressor's energy consumption.

There were other savings opportunities that are applicable to many sites, such as motor replacement (including adopting variable frequency drives (VFDs)), improving exterior lighting, and installing motion sensors.

In addition, there were savings opportunities unique to each industry. For example, for a printing facility, UV curing can be retrofitted or replaced with UV-LED curing. In electroplating, hot baths can be insulated with floating covers (such as "hexies") and bath heater timings can be modified to save money during off-hours by turning equipment off when it is no longer needed.

Recommendation	Annual Reduction	Annual Savings	Energy Savings
Compressor optimization, LED lighting, UV curing	264,000 kWh 830 therms	$24,000	46%
Compressor optimization, LED lighting, insulation	125,000 kWh	$11,900	31%
Compressor optimization, LED lighting, motion sensors	86,000 kWh	$10,140	25%
LED lighting, motor replacements, process improvements	22,440 kWh 600 hours downtime	$102,500	11%
Compressor optimization, LED lighting, VFDs	290,000 kWh	$25,000	36%

City of St. Peter WWTF

Merry Tesfu
Petroleum and Geological Engineering
University of North Dakota

Organization Background

The City of St. Peter Wastewater Treatment Facility (WWTF), established in 1961, discharges clean effluent water to the Minnesota River. In September 2000, the expanded WWTF was built to provide treatment for population and industrial growth projections through the year 2020 at a designed influent flow of 4 million gallons per day. The process contains preliminary treatment, primary treatment, secondary treatment, ultraviolet (UV) disinfection, and biosolids treatment.

"The MnTAP internship program was a unique opportunity that allowed me to gain engineering experience in a wastewater treatment facility, to develop my own project, to work on a collaborative team, and to experience small town life. My experience was extremely rewarding. In addition to sharpening my understanding of wastewater treatment, working in direct contact with the operators, vendors, and city workers, I thoroughly enjoyed working with such a great team of people." ~ MT

Project Background

The City of St. Peter WWTF largely uses electric energy to operate the plant. The plant's annual electric energy usage for 2015 was 2,943,100 kWh. The secondary treatment process consumes about 26% of the total electric energy. The primary components of this system are seven blowers, each 50 horsepower. The main purpose of these aeration blowers is to provide air for the biological aerated filters (BAF). The BAF blowers themselves account for about 24% of the plant's annual electric energy use. The BAF uses biological organisms to remove contaminates such as: ammonia, biochemical oxygen demand, total suspended solids (TSS), and phosphorus.

To remove contaminates, the blower has to provide the right amount of air. Too little air in the aeration basins slows the growth rate of the bacteria, which provides incomplete treatment. No air would make the bacteria consume the entire dissolved oxygen (DO) in the basin and die. On the other hand, too much air is unnecessary for adequate treatment without improving the quality of the effluent water. The sludge handling processes consume 15% of the total electric energy. The system's primary energy-consuming equipment is a single 100 horsepower aeration blower. The biosolids aeration blower consumes about 14% of the plant's total electrical energy use. The blower has to provide the right amount of air to prevent the biosolids liquid from becoming septic

Incentives To Change

The City of St. Peter WWTF expanded in 1994 and improved from a pond system to an advanced technological process in 2000. Since then, it has observed a high DO concentration in the effluent water, indicating over-aeration and an opportunity for aeration energy conservation. Before the intern project, the monthly average effluent DO concentration was 10.52 mg/L. However, the St. Peter facility is only required to maintain at least 5 mg/L DO at the facility effluent to meet their permit. Optimizing the aeration system by reducing DO concentrations through installing variable frequency drives (VFDs) on BAF blowers and changing the supervisory control and data acquisition (SCADA) control set points could save 41% of the BAF blowers' energy use.

The biosolids storage aeration blower was sized for the full tank depth of 17 ft. However, the biosolids storage minimum and maximum liquid levels are typically 3 to 9 ft, respectively, under normal operating conditions. There are no means to control the blower to match aeration output with liquid level. Optimizing the biosolids storage aeration blower through installation of a VFD for control would save 61% of its energy usage.

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SCADA Adjustment of Target Cell Velocity

The number of BAF cells in filtration depends on the influent flow and target cell velocity, a user controllable set point in the SCADA system. St. Peter WWTF was operating at a 2 gpm/ft^2 target cell velocity (TCV) and a mandatory minimum number of three cells in filtration at all times due to high TSS concentrations at the effluent. Adjusting the target cell velocity from its prior 2 gpm/ft^2 value to 1 gpm/ft^2 in the SCADA system slows down the wastewater through the filter media, and at this reduced speed, the BAF will more readily filter TSS. Therefore, it is expected that there is no need to override the system to operate with a minimum of three cells in filtration to control high TSS concentrations. This adjustment allows the plant to operate with a lower number of cells during the low influent flow. It reduces the average number of cells in filtration from three cells to two cells under typical flows. The reduction of cells in filtration decreases the BAF blower energy consumption.

Install VFDs to Reduce Effluent DO Concentration to 7 mg/L

Modeling the aeration system to a reduced effluent DO concentration of 7 mg/L by using VFDs significantly decreases the energy usage. In other words, airflow adjustment is made through reduced blower speeds to approach a fixed average effluent DO concentration (7mg/L). An aeration system model was used to quantify energy savings in the aeration system while ensuring wastewater treatment permit requirements were met. Reducing the blower speed using VFDs decreases the average airflow generated by the blower.

Combined Effects of SCADA Adjustment and VFD Implementation

The combined effects of implementing both recommendations above, the SCADA adjustment of TCV to 1 gpm/ft^2 and reduced DO of 7 mg/L using VFDs, results in a 41% energy savings in the BAF blowers.

Anticipated Maximum Savings Achievable Through Continued Testing

Tests conducted during the intern project period on the above recommendations suggest additional savings may be achievable, should the facility respond well to additional testing. The City of St. Peter WWTF staff are still working to identify the optimal TCV setting by slowly increasing the value in the SCADA to further reduce BAF cell runtime. DO requirements at the effluent are only 5 mg/L, allowing room for further energy savings through blower speed reduction. Additional savings are expected to be achievable through blower speed optimization.

Install VFD to Control Biosolids Blower with Tank Level

Currently, the biosolids blower operates at 2,048 RPM, regardless of biosolids tank level. Reducing the blower speed to 636 RPM during the lowest biosolids liquid level (3 ft) and to 1,220 RPM during highest liquid level (9 ft) using a VFD controlled by tank height decreases the blower energy consumption from 407,200 kWh to 160,700 kWh annually, a 61% reduction in energy use.

Recommendation	Annual Reduction (kWh)	Annual Savings	Status
Opportunity 1: Biological Aerated Filter Blower Efficiency			
SCADA adjustment of target cell velocity	153,600	$12,300	Implemented
Install VFDs to reduce effluent DO concentration	173,600	$13,900	Recommended
Combined effects of SCADA and VFD implementation	289,600	$23,200	Recommended
Anticipated maximum savings achievable	405,490	$32,400	Needs testing
Opportunity 2: Biosolids Storage Aeration Blower Efficiency			
Install VFD to control biosolids blower with tank level	246,500	$19,700	Planned

City of Woodbury

Nathan Landwehr
Environmental Science, Policy and Management
University of Minnesota Twin Cities

Organization Background

The City of Woodbury is a suburb in the southeastern Twin Cities Metro Area. Established in 1967, Woodbury is the largest city in Washington County and the 9th largest city in the state, with 67,855 residents as of 2015. Woodbury prides itself on its water conservation goals and is striving to mitigate increasing water demands as a result of a steadily increasing population.

"This internship gave me an excellent opportunity to make a positive impact on a thriving and progressive community. I gained valuable experience working in water conservation and irrigation best practices, developed a deepened understanding of city infrastructure, and created meaningful working relationships with the city staff." ~ NL

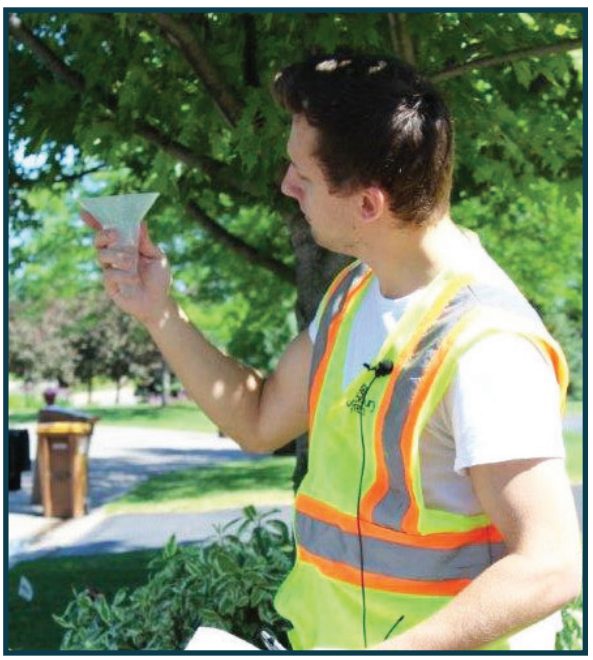
Project Background

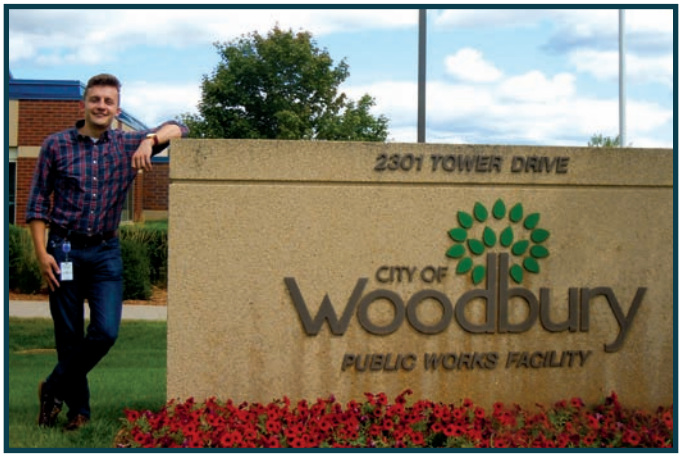
The City of Woodbury established a "Flat Water Use by 2030" goal in 2014 to meet increasing water demands. This means that Woodbury plans to draw only as much water from the aquifer in 2030 as was drawn in 2014. To accomplish this, Woodbury is focusing on implementing water conservation best management practices in all areas of municipal water use. Water used for irrigation represents a significant portion of this total water use during the spring and summer, making it a focus area for improvement. The project is focused on reducing residential irrigation water use, with a goal of developing a pilot program designed to distribute and evaluate the effectiveness of smart irrigation controllers to determine if large-scale distribution of these controllers in the future would be cost-effective.

Incentives To Change

The City of Woodbury pumps water on a peak-demand basis. Currently, the city has 18 wells in operation and is in the process of constructing a 19th well. Evaluation of groundwater use trends shows that current use rates with projected population growth may compromise the long-term sustainability of the Prairie du Chien-Jordan aquifer. As Woodbury grows and water demand increases, more wells may need to be built to meet these demand increases. Building new wells not only represents a substantial cost for the city, but also causes additional strain on the aquifer. Improving water efficiency practices reduces the need to build more wells. Given Woodbury's large and steadily growing population, a significant opportunity exists to optimize water efficiency practices and contribute to sustaining the capacity of the aquifer.

Woodbury manages the municipal water utilities for the majority of properties within the City (private wells were not included in the scope of this project). In addition, Woodbury is responsible for enforcing watering policies. The current policy prohibits residential landscape irrigation of any kind between noon and 5pm





every day and also follows an odd/even structure that only allows odd numbered properties to water on odd calendar days and vice-versa.

SOLUTIONS

The City developed a plan and budget to fully subsidize the purchase and distribution of 100 Rachio IRO 2nd generation smart irrigation controllers to residents that submitted an application and qualified. Qualification was based on objective information on their current irrigation system; this information was used to determine if significant savings could be realized.

Smart irrigation controllers optimize water use in two ways that traditional clock-based controllers cannot. Clock based controllers irrigate on a schedule set by the user. The run times per zone, start times, and dates programmed into the controller are fixed unless changed manually. Smart controllers use advanced scheduling based on lawn characteristics (soil composition, slope of lawn, vegetation, shade, etc.) and also utilize local weather data. Smart controllers automatically skip irrigation if a predetermined precipitation threshold is predicted to be exceeded by a weather forecast. The controller used in this pilot program also estimates water usage and savings.

The first stage of the project involved enrollment of residents and distribution of smart controllers. The city used social media and email notifications to citizen groups connected to city environmental news to inform residents of the opportunity. The intern and city staff developed an application that consisted of a participation agreement with prerequisite criteria, a survey to obtain details about residents' current irrigation system, and additional optional participation methods. Based on the program agreement, residents were responsible for the installation of their new controller.

The second stage involved live-monitoring of water consumption through Rachio's cloud-based technology and conducting irrigation audits to evaluate system performance and calculate water usage. This information was ultimately used to determine total savings. To calculate actual water savings per unit, five irrigation audits were conducted. An irrigation audit is a systematic process of determining the distribution uniformity of each zone in an irrigation system. Distribution uniformity is a measure of how evenly an irrigation system distributes water over a zone. A zone is defined as a section of the irrigated property based on location of sprinkler heads and the area covered. A precipitation rate, or the average output of water by the system, is also determined during an audit. The savings data from the five audits was averaged and extrapolated to estimate the savings for all 100 units.

Continue Purchasing and Distributing Smart Controllers to Qualifying Residents

Based on the audits, clock-based controllers each used approximately 74,490 gallons per year. The average annual savings upon implementing the smart controllers was approximately 37,074 gallons per year each or a 50% savings. It is recommended that Woodbury continue to purchase and distribute smart controllers to realize additional savings. It is also recommended that the city follow up via survey with current pilot program participants in one year to get additional feedback on the controllers and to verify the amount of water saved per household.

	Implementation Cost	Annual Water Savings (Gal)	Annual Cost Savings (Per 100 Residents)	Status
Purchase and distribute smart controllers	$15,000	3,000,000	$2,640	Implemented
Continue to purchase and distribute smart controllers	$15,000	3,000,000	$2,640	Recommended

*Over a 5 month irrigation season

Ecolibrium3

Hanne Guthrie
Chemincal Engineering
University of Minnesota Duluth

Organization Background

Ecolibrium3 in Duluth focuses their work on energy efficiency, sustainability and neighborhood revitalization. Previous projects include Giving Comfort At Home, where home audits provided energy improvement assistance for income-eligible, elderly, disabled and/or veteran homeowners that may not qualify for other loans or assistance. Some of their current projects include the Georgetown University Energy Prize competition, the Duluth Energy Efficiency Program, and a resilient power demonstration at the Hartley Nature Center, a solar and battery storage project.

"This project provided a unique opportunity for me to work with multiple small businesses in a community setting. Not only did I learn a lot from each of the small businesses but I also gained knowledge from the connections I made with other community members. I have no doubt I will use this experience and what I have learned from this project in the future." ~ HG

Incentives To Change

Lincoln Park, a large industrial and residential community in Duluth, is part of the EPA's, "Making a Visible Difference in Communities" project that identified environmentally overburdened, underserved, and economically distressed communities in the United States. This community has a variety of light manufacturing, automotive, retail and distributors located in some of the oldest building stock in Duluth. Small businesses may or may not be aware of programs that are available to them, and are often at different stages of implementing sustainable solutions. The internship provided and opportunity to help several smaller neighborhood businesses.

Project Approach

This project had two parts: general benchmarking and deeper assessments of local small businesses. Businesses received assistance in setting up ENERGY STAR® Portfolio Manager accounts that would allow energy, water, and waste tracking to look for changes when new projects are completed. The deeper assessments took this one step further to find energy, water, and waste savings by looking at the production process. Since energy analysis is the first step toward identifying opportunity, Minnesota Power's commercial auditors, Energy Insight, provided energy audits to two of the companies in this project. These audits delivered specific recommendations, including available rebates, to determine return on investments.

Two of the local businesses that participated in this project are soft good manufacturers. Aerostich was founded in 1983 and is an authorized Gore-Tex manufacturer that makes lightweight armored motorcycle suits that offer a high level of protection in weather and crashes. Frost River handcrafts heritage waxed canvas packs, bags, luggage and accessories that are generation-proof, reliable, and purpose-built for function. These companies focused on compressed air, scrap recycling, and lean manufacturing.

The third company that was part of this project is a local beverage producer that focused on ways to reduce water. All of these companies are already interested in continuous improvement and being good stewards to the neighborhood and the environment.

SOLUTIONS

Compressed Air

Compressed air studies were performed at both of the soft good manufacturers. The studies helped them understand how the air is used and identified leaks in the system. Another reduction opportunity identified was shutting down a machine when it is not in use. By fixing leaks and reducing the runtime of a machine that requires compressed air, the companies can save $1,600 and 14,000 kWh per year.

Water Use Reduction

The tanks used in beverage manufacturing are cleaned in succession and have four cleaning steps. Currently, all cleaning water and rinse water is discarded. By reusing the final rinse water, the company could save 41,000 gallons of water annually. Investing in a hose water meter and optimizing temperature and wash chemistry could save an additional 62,000 gallons, if further testing assures complete sanitization. Installing low flow cleaning nozzles would save 27,000 gallons of water annually.

Waste Reduction

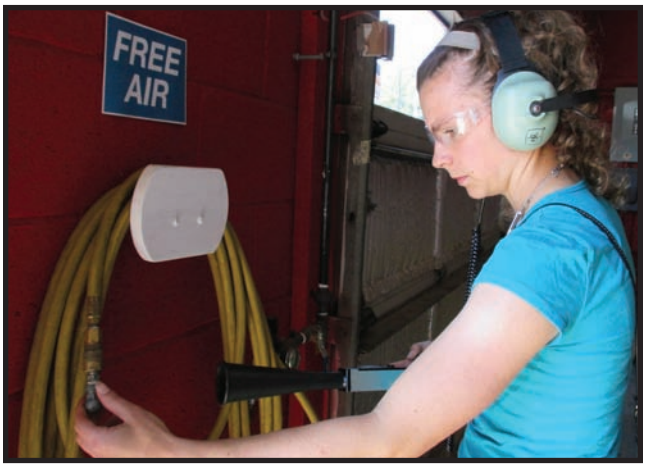
Like all businesses, these Lincoln Park companies have a waste stream associated with their processes. For example, soft good manufacturers create a lot of scrap fabrics from production. Finding uses for scraps involves creative ideas and researching multiple connections. There are many crafters and non-profits in Lincoln Park, and a few were contacted to find possible reuse options. There is discusion of creating an event in Lincoln Park using the scrap materials to start conversations about waste reduction and reuse and also to bring the neighborhood together. These materials could also be listed on the Minnesota Materials Exchange. If all of the scrap materials could be reused, more than 3,400 lbs of waste could be eliminated from the landfill.

Lean Assessments

Lean manufacturing is usually associated with larger manufacturing companies, but is applicable to smaller manufacturing businesses as well. As an introduction to lean manufacturing, a time study was conducted with the two soft good manufacturers, and a value stream map was created for both of their processes. This allows them to look for process inefficiencies and bottlenecks and gives them an opportunity to implement improvements. 5S, another lean manufacturing methodology, is recommended for both companies as a way to reduce non-value added time and increase throughput.

Energy Assessments

Energy Insight conducted energy assessments at two of the businesses. Business-specific recommendations included taking an old chiller off-line to save $1,400 and 17,000 kWh per year, and adding shades over mini-split AC units to keep the air intakes and units cool, saving $1,100 and 13,500 kWh per year. A recommendation common for many businesses is to replace older fluorescent lights with LEDs. If implemented, these businesses could save $5,400 and 57,000 kWh per year.



Recommendation	Annual Reduction	Annual Savings	Status
Compressed air optimization	14,000 kWh	$1,600	Recommended
Water use reduction	130,000 gallons	$1,800	Recommended
Waste reduction	3,400 lbs	Savings from dumpster size reduction	Recommended
Value stream mapping	Improved productivity	Time savings	Recommended
Energy assessments	87,500 kWh	$7,900	Recommended

G&K Services

Katherine Venne
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Company Background

G&K Services was founded as a dye house in Minneapolis, Minnesota in 1902. They have since expanded into an industrial laundry facility that rents workplace uniforms, towels, floor mats, linens, and many other reusable textiles to a wide range of industries. In addition, G&K Services provides a direct purchase program for garments, facility cleaning, and safety products. G&K Services is based in Minnetonka, Minnesota and has three laundry processing facilities in the Twin Cities as well as others throughout the state and across the U.S.A and Canada.

"Working with MnTAP and G&K Services gave me the opportunity to learn about an industry and an area of engineering I previously knew little about. This internship allowed me to apply the skills I've gained in school to real world challenges and help G&K Services achieve its environmental stewardship goals" ~KV

Project Background

G&K Services is committed to incorporating environmental stewardship into everything they do; it is one of their core values. This project was focused on waste reduction at one of their laundry processing facilities in the Twin Cities. This facility, known as Minneapolis Industrial, processes garments, print towels, shop towels, floor mats and mops as well as other reusable textiles. Two main opportunities for waste reduction were identified at Minneapolis Industrial: solid waste reduction and reduction of chemical oxygen demand (COD) and total suspended solids (TSS) in their wastewater.

Incentives To Change

G&K Services is committed to upholding their core values and this project fits in directly with company goals. From data collected during this project, it is estimated that Minneapolis Industrial generates over 163 tons of solid waste per year. Reducing the amount of solid waste produced would both benefit the environment and save the company money on waste removal. In addition, in recent months, the concentrations of COD and TSS measured in the wastewater have been higher than in the past. This has led to a significant increase in the strength charge that is billed to the company quarterly by the Metropolitan Council. G&K Services is interested in treating their wastewater to remove these contaminants, which will lower the strength charge and the cost of sludge removal.

SOLUTIONS

Update the Current Employee Recycling Program

The Minneapolis Industrial plant has a recycling program in place for employees. Recycling containers are available for cans, bottles, and cardboard in various locations throughout the plant. Participation in the current program could be increased by adding additional recycling

containers, pairing recycling containers with trash cans, providing additional employee education, and placing multilingual pictures with signs by all recycling containers. These updates would add an element of convenience to the current recycling program and encourage employee participation. If this option succeeded in diverting 75% of the recyclables currently thrown in the trash, 3,600 pounds per year of solid waste would be reduced, saving the company around $190 per year.

Recycle Additional Items

In addition to the items currently recycled at Minneapolis Industrial, there are opportunities to recycle even more of the solid waste generated at the plant. Miller Waste Mills is a textile recycler in Winona, Minnesota that is currently working with G&K Services to implement a recycling program at another plant in the Twin Cities area. Miller Waste Mills is willing to take clean textiles, clean plastic film, damaged floor mats and hangers. If Minneapolis Industrial implemented this recycling program and 75% of the textiles, clean plastic, floor mats, and hangers generated yearly at the facility were recycled, the amount of solid waste generated would be reduced by more than 168,000 pounds per year, saving the company over $10,700 per year.

Consider Implementing a Wastewater Treatment System

Textiles processed at Minneapolis Industrial are often heavily soiled. Washing these textiles leads to high concentrations of chemical oxygen demand (COD) and total suspended solids (TSS) in the wastewater leaving the plant. Three different wastewater treatment systems were assessed for of effectiveness, feasibility, and cost of implementation and operation. The three treatment systems analyzed were: a dissolved air flotation system (DAF), a wastewater centrifuge, and a Norchem UltraPure ceramic filtration system. It was found that with all three systems the cost of yearly operation exceeded the estimated cost savings in terms of reduced surcharges and sludge removal costs. The system that showed the highest cost savings, most waste reduced, and highest removal efficiency was the Norchem system. This treatment system also has the option of water reuse without any additional equipment required. With the Norchem system it is estimated that 1,700,000 pounds of COD and 233,000 pounds of TSS could be reduced yearly. This would save the company approximately $251,800 per year.

Although none of these options currently show cost savings greater than yearly operating costs, wastewater treatment should still be considered. Of the three options analyzed, the Norchem UltraPure ceramic filtration system proved to be the best option for waste reduction and cost savings. However, other types of wastewater treatment should be analyzed and future strength charges should be monitored. The right treatment option for this specific plant will balance efficiency and cost.

Recommendation	Annual Reduction	Annual Savings	Status
Add additional recycling containers	3,600 lbs	$190	Under review
Employee recycling education			
Recycle damaged textiles, floor mats, clean plastic film, and hangers	168,000 lbs	$10,700	Under review
Install a Norchem Ultrapure wastewater treatment system	1,700,000 lbs COD, 233,000 lbs TSS	$251,800	Under review

Hennepin County Medical Center

Rachel Kosse
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University of Minnesota Twin Cities

Company Background

Hennepin County Medical Center (HCMC) is a major employer and economic engine in downtown Minneapolis, employing over 6,000 full-time-equivalent employees. HCMC is Minnesota's premier Level 1 Adult Trauma Center and Level 1 Pediatric Trauma Center with many nationally recognized programs and specialties. It is an essential teaching hospital for doctors who go on to practice throughout the state, and is also a safety-net hospital, providing care for low-income, uninsured and vulnerable populations. The hospital's six campus buildings encompass three million square feet.

Hennepin County Medical Center

"Working with Hennepin County Medical Center has taught me so much about resource use and conservation in a healthcare setting. I have gained invaluable experience through working out solutions to meet complex water and energy saving goals. It was inspiring to see a large urban hospital work so hard to improve environmental impact with such a high level of concern for community health." ~RK

Project Background

To focus on the issue of water conservation within its facilities, HCMC sought out a water conservation intern from MnTAP to provide a dedicated resource to analyze water use and look at current practices with new eyes from outside the healthcare field. The goals of the project were to document current water use, develop measures to reduce current and future use, and foster an atmosphere of environmental stewardship. In cataloguing current use, the intern discovered that HCMC used 46 million gallons of water in 2015.

Incentives To Change

HCMC is committed to sustainable ideals. It strives to be a leader in water and energy savings, with a goal of reducing water use by 10%. The state of the environment strongly affects the health of community members and, therefore, the health of HCMC's patients. Thus, HCMC is committed to saving resources and reducing their impact on the environment. In pursuit of this goal, HCMC hired a sustainability coordinator and established a sustainability team, which has worked to implement many sustainablity goals that benefit not only the community but also the health of HCMC's employees.

SOLUTIONS

Update Domestic Fixtures

Updating domestic fixtures to low flow options is a cost effective way to save water. Adding aerators to the sinks can reduce their flow from 2.2 to 1.0 gallons per minute (gpm). New low flow shower heads use 1.5 gpm compared to 2.5 gpm for older models. Low flush toilets can reduce water use from 3.5 gallons per flush (gpf) to 1.6 gpf, and dual flush models use even less water, at 1.0 gpf for approximately 50% of flushes.

Replace Equipment

Replacing water intensive equipment such as washers, sterilizers, dishwashers, and washing machines with more efficient models can save a vast amount of water. If the water saved is heated, there is an energy savings as well. Historically, HCMC replaces equipment as it reaches end of life. Resource savings could justify earlier replacement. For example, the washing machines in the psych department are still functional; however the payback to replace them is only five months. Rebates may also be available for upgrading to new equipment that is more energy efficient, including reductions in heated water.

Eliminate Use of Cold Water to Cool Discharge

Cold water used to be necessary to cool discharge water from the washers in order to meet regulations that stated the discharge water temperature cannot exceed 140°F. This regulation has since been updated to allow up to 180°F discharge. Therefore, after testing the discharge water temperatures, the use of cold water to cool discharge was proven no longer necessary, saving 1.5 million gallons of water annually.

Reuse Reverse Osmosis (RO) Reject Water

Every year, 520,000 gallons of reject water from RO systems goes to drain. This water is high quality clean water, suitable for reuse. Floor cleaning uses 5,000 gallons of water per month. The room where the floor machines are filled is relatively close to a new RO treatment system being installed, which will produce approximately 4,500 gallons of reject water per month. Irrigation uses approximately 50,000 gallons of water monthly throughout the summer months. A nearby RO system that could feasibly be rerouted for irrigation produces 27,000 gallons of reject water monthly year-round. In addition to these two systems, another system produces 70,300 gallons of reject water plus 72,800 gallons from system flushing that could be suitable for future reuse projects.

"Rachel was a wonderful asset to HCMC's facilities team. She worked independently, found savings opportunities that HCMC had overlooked, and provided concrete recommendations for implementing her proposals. The anticipated savings are significant, both in water reduction and financially."

~Ann Eilbracht-Thompson,
Senior Director of Support Services, HCMC

Recommendation	Annual Reduction	Annual Savings	Status
Update domestic fixtures	5,190,000 gallons 15,200 therms	$57,400	Ongoing
Replace equipment: Washers	2,100,000 gallons 6,000 therms	$32,000	Implemented
Replace equipment: Sterilizers	2,800,000 gallons 20,000 therms	$54,000	Planned
Replace equipment: Dishwashers	720,000 gallons 4,000 therms	$16,600	Recommended at end of unit life
Replace Equipment: Washing machines	530,000 gallons 3,000 therms	$7,000	Recommended
Eliminate use of cold water to cool discharge	1,500,000 gallons	$14,000	Implemented
Reuse reverse osmosis reject water	180,000 gallons	$1,700	Recommended

IBM

Daniel Sales
Chemical Engineering
Washington University in St. Louis

Company Background

IBM has been a leader in the technology industry for the better part of a century. The IBM Rochester facility was established just over 60 years ago. At 3.1 million square feet with 33 buildings on its campus, the Rochester site had its hand in manufacturing, chemical distribution, data centers, labs, hardware and software. Presently, manufacturing and chemical distribution have been removed, and now a variety of tenants lease the vacant space. IBM has managed to decrease its footprint from 33 to 8 buildings. Reducing costs in these buildings served as the focus of this project.

"You can have all of the data in the world to back up your claims, but unless you make your project matter to the people who use it, nothing will be done. Progress requires a partnership between people who are doing what they think is best. When goals align, things can move forward." ~DS

Project Background

Opportunities were identified and presented to MnTAP by the site mechanical engineer with three major goals: 1) Reduce peak power draw in the utility plant by dropping the load on the chillers using a thermal storage tank; 2) Identify cooling coils that have been fouled and design a system that will prevent them from becoming larger issues; and 3) Present an alternative corrosion inhibitor to the current molybdenum based one on-site that will reduce the waste the site generates.

Incentives To Change

IBM is a global leader in innovation and historically has a reputation for environmentally conscious practices. Since 1973, IBM has pushed a climate change initiative, including reducing energy consumption and greenhouse gas emissions. The company has a 4% annual energy reduction target. At the site level, reduced energy costs reduce the cost to operate the facility, and this lowered expense improves the bottom line for IBM and businesses that share the facility.

SOLUTIONS

Use Thermal Storage Tank as Thermal Battery

There is an onsite thermal storage tank full of water that has previously been used as an emergency backup for the facility. This tank has extra capacity that can be used during the day to reduce peak demand of the onsite chillers. As the site power consumption approaches 700 kW of the peak draw from 2015, the storage tank water is used and chillers are turned down or off. The goal is to maintain this 700 kW difference between the reference value and the actual power draw. Utility demand charges are based on the 15-minute window of highest energy consumption each month. Therefore, if the schedule is followed diligently every day, there is a potential to decrease the peak power by 700 kW each month for 8 months of the year for an annual savings of $104,000.

Install Pressure Independent Valves on Large Air Handlers

The site operates over 450 air handling units; often, there is more chilled water than is necessary sent through the air handlers. Pressure independent valves will restrict flow to prevent overflowing and optimize heat transfer to reduce flows and energy draw overall. Inside the valve control mechanism in the chilled water system, an electronic control is calibrated to each HVAC unit. This controls flow to prevent overflowing of water and wasted energy. A previous case study showed results in a system larger than IBM's. Pressure independent valves are recommended for installation in larger units where payback will be noticeable. Potential annual savings is 1,100,000 kWh and $93,000.

Clean Exterior of Coils Due to Fouling

Build-up on the surface of cooling coils can result from debris or dust in the system. When this happens, the heat transfer between the air and the fouled cooling coils is diminished. The system compensates by demanding more water to achieve the same amount of cooling. Fouled coils have been identified using an infrared camera and documented for recommended cleaning. Cleaning of these coils is planned with an estimated annual savings of 26,200 kWh and $37,000.

Purge Plugged Coils

When water from the larger sized pipe headers drops down into the much smaller pipes of the air handlers, there can be buildup of solid materials. This does not create a problem in the large header, but in the small pipes it can cause plugging. If left unchecked, the plugging can cause the whole coil to become clogged which requires a full coil replacement. Coils with potential for plugging have been documented and recommended for purging. This is being implemented with an estimated annual savings of 5,000 kWh and $24,000.

Maintain Coils with Infrared Camera

Existing air handler maintenance audits annually inspect dampers and air flow. In order to prevent the large scale issues associated with severe clogging of coils, it will be beneficial for an additional duty to be added to this maintenance procedure. It is recommended that maintenance take pictures of the coils with an infrared camera to check for signs of fouling or plugging during the annual damper check in order to address minor problems before they become more costly issues with a potential annual savings is $15,000.

Replacing Molybdenum-based Corrosion Inhibitor

IBM is limited in what it can safely discharge from its chilled water system due to the presence of molybdenum in its corrosion inhibitor. This results in roughly 41,000 gallons of hazardous water shipments per year due to 170 pounds of molybdenum in this wastewater. By removing the molybdenum based corrosion inhibitor and installing a less hazardous alternative, the hazardous shipments of wastewater will be eliminated, saving $41,000 per year. This project will be modeled after the project completed in 2011 by the IBM branch in Raleigh, North Carolina.

Recommendation	Annual Reduction	Annual Savings	Status
Use thermal storage tank as thermal battery	700 kW peak	$104,000	Implemented
Install pressure independent valves	1,100,000 kWh	$93,000	Recommended
Clean exterior of coils	26,200 kWh Coil maintenance	$37,000	Implementing
Purge plugged coils	5,000 kWh Coil maintenance	$24,000	Implementing
Maintain coils with an infrared camera	N/A	$15,000	Recommended
Replace corrosion inhibitor	170 lbs waste	$41,000	Recommended

Lorentz Meats

Nicholas Drews
Chemical Engineering
University of Minnesota Twin Cities

Company Background

Lorentz Meats is a full-service meat packing company that specializes in natural, organic and grass-fed meat processing. They are United States Department of Agriculture inspected and Safe Quality Food certified, putting them in-line with the Global Food Safety Initiative standards. They place a high value on obtaining and retaining the mutual respect of their employees, community, products, industry and the environment. They serve national niche meat brands as well as local farmers, providing services from slaughter to retail-ready packaging, which includes sausage making as well as custom curing and cooking.

"My work with Lorentz Meats has given me the opportunity to interact with so many different people throughout the organization, from operator to owner and everything in between. I've come away from the internship with a greater appreciation of the viewpoints of others that may be in opposition of my own. My experiences during this MnTAP internship have undoubtedly started me in the right direction as I look to start my professional career." ~ND

Project Background

Lorentz Meats applied to host an intern to optimize the industrial refrigeration system used in the plant for its continual cold storage needs and analyze the water usage of the various meat processing and sanitation practices for potential reductions.

Incentives To Change

The cost of processing and storing meat can be high. The process requires the use of water, electricity and natural gas. In 2015, Lorentz Meats used 2,136,000 kWhs of electricity, 5,835,000 gallons of water, and 31,600 therms of natural gas. In 2015, Lorentz Meats paid $230,000 for electricity, $112,000 for water and sewer, and $23,000 for natural gas.

SOLUTIONS

Clean Evaporator and Condenser Coils

Condenser coils were blinded with chaff and dirt reducing air flow through the coil to near zero in places and thus reducing system capacity. Cleaning the coils reduced fan operating hours and energy consumption by about 9,400 kWh and $700 per year. Cleaning a visibly dirty evaporator allowed increasing the evaporator temperature setpoint by 3 degrees. Cleaning both condensers and evaporators is now a scheduled task.

Lower Minimum Condensing Head Pressure

Lowering minimum condensing temperature allows the refrigeration compressor head pressure to float down with decreasing outdoor air temperatures, which reduces how hard the compressors work to move heat out of the facility. This can be accomplished to a degree through manual adjustment of the setpoint, which could save 89,000 kWh and $6,800 annually.

Install Electronic Expansion Valves on Evaporators

Greater saving can be generated by installing electronic expansion valves on the evaporators which allow a greater reduction in condensing temperature by better controlling refrigerant flow. Upgrading the refrigeration system, at a cost of $77,000, should save 428,000kWh and $32,500 per year.

Install ECMs on Evaporator Fans

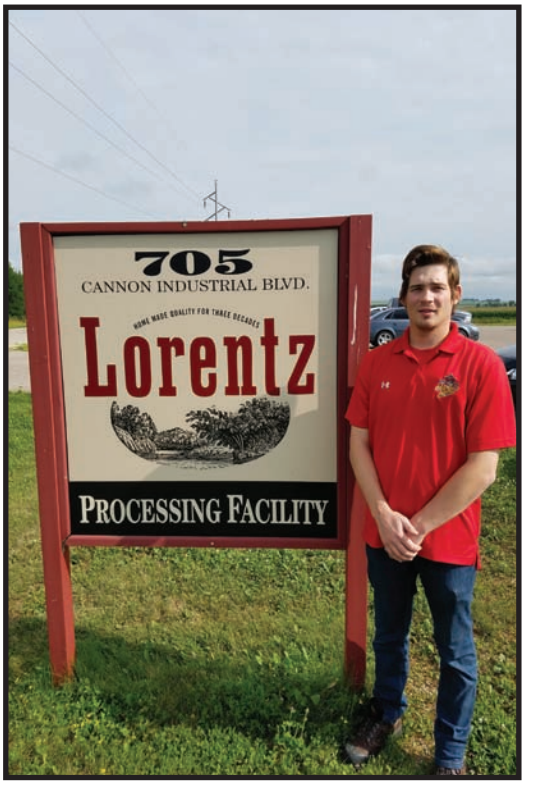
Electronically Commutated Motors (ECM) are about 30% more efficient than the traditional shaded pole motors used at Lorentz Meats. There are 109 evaporator fans in the facility, 87 of which have drop-in ECM replacement options. Replacing the 87 fan motors with ECM should reduce electric consumption by about 162,000 kWh and save $12,000 annually. Replacing all the fan motors immediately would cost about $58,000, with a 5 year payback, so Lorentz has made the decision to replace the motors when they fail where the incremental cost for replacing all the fan motors over time will be about $9,000. During the two months following the project, three motors have been upgraded to ECMs.

Water Reduction Options to be Evaluated Further

A carcass washer is important for the initial cleaning of the meat being processed and uses 27 gallons per half carcass. The bottom two rows of nozzles spray 16% of the total flow but this water only touches the very largest carcasses. During the next plant expansion, planned for the next few years, the possible automation of nozzle selection by carcass size will be further evaluated. This could save 119,000 gallons of water and $3,400 per year. Sanitation is done by a contractor and, while food safety is paramount, if hot water use can be reduced by 10% using lower flow nozzles, there is the potential to save 220,000 gallons and $5,300 in water and gas costs.

Improve Lighting Efficiency

Older sections of the building have T8 and some T5 lighting, upgrading to LED fixtures and adding motion sensors to lights in seven rooms where occupancy is variable should annually save 76,800 kWh in direct lighting electrical consumption and another 4,000 kWh in reduced refrigeration, saving $7,100. Lighting upgrades are expected to cost $16,000.



Recommendation	Annual Reduction	Annual Income/ Savings	Status
Clean evaporator and condenser coils	9,400 kWh	$700	Implemented
Lower minimum condensing head pressure	89,500 kWh	$6,800	Recommended
Install electronic expansion valves on evaporators	428,000 kWh	$32,500	Recommended
Install ECMs on evaporators	162,000 kWh	$12,000	Recommended
Install carcass cleaner shut-off valve to lower rows	119,400 gallons 1,400 therms	$3,400	Recommended
Install lower flow nozzles on overnight sanitation equipment	220,000 gallons (10%) 1,500 therms (10%)	$5,300	Recommended
Improve lighting efficiency	76,700 kWh	$7,100	Recommended

Nordic Ware

Roopesh Pushpala
Industrial and Systems Engineering,
University of Minnesota Twin Cities

Company Background

Nordic Ware is a kitchenware manufacturer in St. Louis Park employing about 400 people. Starting in 1946, Nordic Ware is best known for its Bundt design cake pans. They also produce a large variety of cookware, bakeware and microwave accessories. Production operations include metal fabrication, parts washing, liquid and powder coating application, and plastic molding. Nordic Ware also operates an Industrial Coating Division, which provides custom surface coating.

"My internship at Nordic Ware has given me the exposure to industrial working standards and an opportunity to investigate numerous fields of engineering. My work as a process engineer broadened my ability to apply process efficiency and lean principles which will be a key aptitude all through my career." ~RP

Project Background

Fabricated and cast parts are cleaned in one of two large belt conveyor washers to remove stamping oils and machining coolants prior to being painted and packed for shipping. These three-stage washers use natural gas, cleaning chemicals, softened and de-ionized water prior to a force air drying step.

Parts are painted on one of six lines which move parts on a chain-on-edge conveyor, past automated compliant paint spray guns, while parts spin on fixtures as they are painted. Parts are manually transferred to a belt-driven curing oven and the process is repeated for the opposite side of the part. Various forms of rectangular cookware, such as griddles, are increasing in popularity and could benefit from alternative processing methods. Nordic Ware wanted to optimize the performance of these cleaning and coating lines.

Incentives To Change

Nordic Ware takes sustainability very seriously and believes the term reaches far beyond what a product is made from and whether it can be recycled or not. Goals for this project involve reducing energy consumption, VOC emissions and production costs. Improvements in productivity, quality, machine uptime and energy efficiency aid Nordic Ware in efficiently utilizing resources and meeting customer expectations.

SOLUTIONS

Optimize Washer Operation

Several opportunities were investigated which optimize the water and energy use of Nordic Ware's two industrial parts washers. Operators of the washers noticed increasing levels of foam in the first rinse stage which could be reduced by increasing the water flow. The intern worked to optimize and standardize the height settings of an air knife to direct the cleaner back into the first stage

without drying the cleaner on the parts. Rinse water spray pressure settings were also reduced and standardized based on part weight to minimize foam formation. Spray nozzle maintenance procedures were implemented at this time. Foaming was also reduced by converting the make-up water of the first rinse to city water instead of softened water. Overflow from the de-ionized (DI) water rinse stage was routed to the first rinse to reduce hardness and reuse the water. Elimination of the foam lead to adjustments to the water flow which reduced water usage for the washers.

After implementation of the suggestions to improve rinsing with city water, the intern focused his attention on the use of DI water consumption in the final rinse. The first step was recalibration of the DI water meters and sensors used to monitor the water quality in this rinse. New spray nozzles were then purchased and installed to provide a halo of water with very good rinsing properties with a much lower water flow-rate and achieve spot-free parts. These recommendations have been implemented and reduced the washer water consumption by 55%.

Implement Overhead Coatings Line with IR Oven

Paint transfer efficiencies were calculated for multiple products measuring coating usage during several shifts with various paint line leaders. Tests found significant improvements in paint transfer efficiency when rectangular products did not rotate and were fixed in place on the conveyor. Options considered include installation of an overhead line which would allow for increased part density by hanging up to six products per fixture and paint application of both sides in one pass. This suggestion includes passing the overhead conveyor though a new infra-red (IR) curing oven. Work is underway with Nordic Ware's coating and equipment suppliers to facilitate electrostatic paint application, which would improve paint transfer efficiency even further. It is estimated that the new line would improve paint utilization by 28%, increase production throughput, and reduce the labor needed for transferring product.

Adopt Standard Operating Procedures

Lean manufacturing principles were used to evaluate, improve, standardize and document work methods on the washer and coating lines. Standard operating procedures on the wash line include checking the conductivity of the rinse tanks at regular intervals, setting appropriate line speed, and adjusting the height of the air knife. Implementing the standard procedures can reduce down time and product defects. Standard operating procedures on the paint line include checking the pattern of the spray guns, time of spray, atomizing air pressure, rotating speed, line speed and also the production efficiency to increase the productivity while reducing waste and downtime.

Recommendation	Annual Reduction	Annual Savings	Status
Optimize washer operation	9,093,000 gallons of water 28.5 tons of salt	$86,400	Implemented
Implement overhead coatings line with IR oven	3,300 gallons of paint 6.80 tons of VOC and 75% labor	$367,000	Recommended/ investigating further
Adopt standard operating proceedures	Reduced process defects	N/A	In progress

R&D Systems

Omar Hammami
Chemical Engineering
University of Minnesota Twin Cities

Company Background

R&D Systems, Inc. is a Bio-Techne company that is based in Minneapolis, Minnesota. They specialize in producing biological reagents such as antibodies, cytokines, and recombinant proteins for use in research and development. R&D Systems also produces enzyme assay kits and clinical controls. They launched their first product, a platelet-rich-plasma control, in 1977. R&D Systems' products are driving research in laboratories and universities worldwide. Their Minneapolis facility employs 700 people, and counting.

"My MnTAP internship gave me a glimpse into the 'real world' of engineering. I learned how to better assemble and pitch ideas and how to complete big projects one step at a time." ~OH

Project Background

R&D Systems uses about 11 million gallons of city water per year to run various lab equipment and supply reagent grade water to the labs. The main focus of the project was reducing the water usage of the lab water systems. The other objective was to find ways to conserve energy in the facility.

Incentives To Change

R&D staff saw an opportunity to reduce resource consumption in the laboratories and requested MnTAP's assistance to help facilitate the process. Besides financial incentives such as lower utility bills, R&D was motivated by a vision of a greener, more sustainable laboratory environment.

SOLUTIONS

Reduce Point-of-Use Polisher (PUP) Purge Flow Rate

The PUPs are the final water purification step. The 16 PUPs purge water continuously, at an average flow rate of about 6 gallons per hour. The flow rate on one PUP was reduced to 0.16 gph using a smaller orifice flow restrictor on the purge stream. The unit was monitored for several weeks, and no issues with water quality arose from the lower purge rate. By reducing the flow rate with a smaller orifice on all PUPs, R&D will save 1.6 million gallons of water annually. Since the reverse osmosis systems will run less often, this solution also saves 8,000 kWh per year.

Increase Reverse Osmosis Recovery

Reverse osmosis (RO) is one step in the process of generating reagent grade lab water. Two RO systems are operating below their optimal recovery. The concentrate stream flow rate is set by the venturi injector, a type of differential pressure injector that creates a vacuum for the degassing membrane. If the size of the venturi injector is decreased, the concentrate flow rate is reduced and recovery is increased. Swapping out the venturi injectors on two RO units for smaller models will save 520,000 gallons per year.

Optimize Poultry Cooker Cooling Water

One RO unit has two RO membrane elements, whereas the others have four. Due to the lower number of

membranes, this RO unit ran at much lower recovery (<30%) and the permeate flow rate was half the other units. If two additional membrane elements are installed, the productivity (in terms of permeate flow rate) and recovery will increase. The pump will run less often, saving about 400 kWh per year. After installing a smaller venture injector, a total 230,000 gallons of water will be saved annually.

Retrofit Autoclave with a Temperature-Controlled Solenoid Valve

R&D has several autoclaves, or steam sterilizers, for cleaning glassware. One unit was using a constant stream of single pass cooling water. A simple water conservation retrofit kit consisting of a temperature-controlled solenoid valve will stop the constant flow of cooling water to the sterilizer. The water will flow only when the discharge is above 140°F, reducing water usage by roughly 62% according to the manufacturer. With the retrofit kit installed, the autoclave will use 324,000 fewer gallons of water each year.

Increase Temperature of Ultra-Low Temperature Freezers

R&D has over 100 ultra-low temperature freezers for biological sample storage. All units run at -80°C. Research from Stanford and Harvard has shown that -70°C is generally a better set-point for this type of freezer. Raising the temperature set-point will save approximately 1,000 kWh per unit, with no cost. This solution is recommended for 70 long-term storage freezers that are rarely opened for an overall savings of 70,000 kWh per year.

Reduce PUP Flushing Time

It was observed that some researchers flush the PUPs, or let water run to clear out tubing, for 15-20 minutes each morning. The standard operating procedure (SOP) calls for just two minutes of flushing before use, and flushing for longer has no benefit. Reducing this purge time will save 78,000 gallons per year.

Install a VFD on a Water System Pump

While most of the pumps in the lab water systems already have variable frequency drives (VFDs), one did not. Installing one will save approximately 9,000 kWh per year.

Recommendation	Annual Reduction	Annual Savings	Status
Reduce PUP purge rate using smaller orifices	1.60 million gallons 8,000 kWh	$15,300	In Progress
Increase recovery of RO unit by switching venture injector	520,000 gallons	$4,700	In Progress
Increase recovery of RO unit by adding 2 membranes and a smaller venturi injector	230,000 gallons 400 kWh	$2,100	In Progress
Install retrofit kit on steam sterilizer	324,000 gallons	$2,964	Recommended
Increase temperature of 70 ULT freezers to -70 °C	70,000 kWh	$5,600	Recommended
Reduce PUP flushing time by following SOP	78,000 gallons	$720	Implemented
Install VFD on pump	9000 kWh	$710	In Progress

TEL FSI, Inc.

Alex Mantos
Bioproducts and Biosystems Engineering
University of Minnesota Twin Cities

Company Background

TEL FSI, Inc. manufactures semiconductor production equipment and specializes in wafer cleaning and surface preparation systems. Located in Chaska, TEL FSI produces machinery, such as the ORION, ANTARES, and ZETA that clean wafers by removing nanoscale particles and films. These tools use robotics to transfer wafers that will eventually be etched and go through photolithography to become microchips.

"The MnTAP intern program offered me a unique opportunity to lead and design a project that aligned with my environmental values. Being able to effect positive change was incredibly rewarding. The program also offers variety; one day I was meeting with a VP and the next I was sorting through trash. MnTAP gave me the confidence to approach engineering challenges using creative means." ~AM

Project Background

TEL FSI has set reduction goals concerning water, liquid nitrogen, and waste with opportunities available in each area for reduction. TEL FSI's primary focus is to decrease their annual water usage, specifically to reduce deionized water usage in the process lab. The company identified that 75% of their deionized (DI) process lab water use is water that is sent to the drain instead of reclaimed through the bypass loop. Additionally, they would like to better understand which equipment and processes are responsible for the majority of their liquid nitrogen usage. Finally, TEL FSI has a 2015 recycling rate of 70.6% which leaves nearly 30% of their waste to be sent to the landfill. With those values in mind, there are three main focus areas for this project: reduce water usage, reduce liquid nitrogen and nitrogen gas consumption, and optimize recycling.

Incentives To Change

A major incentive for change comes from TEL FSI's corporate goals to reduce their environmental impact in water, energy, and waste. TEL FSI supports these corporate goals with site-wide initiatives to reduce water usage for 2016 to less than the 2015 level of 18.5 million gallons. Additionally, TEL FSI has a goal of recycling at least 72% of waste by 2017 and TEL has set a goal of recycling 97% of all waste for their subsidiaries. Cost is another motivator since liquid nitrogen, water usage, and associated costs are significant and continue to rise.

SOLUTIONS

WATER CONSERVATION

Decommission ORION 1

The ORION 1 is a Process Lab tool that utilizes both water and nitrogen gas in an idle state and during wafer cleaning. The ORION 1 is connected to the deionized (DI) water supply loop, bypass loop and several drains. Testing shows this unit is responsible for 55% of the process lab water sent to the drain. Since the tool has not been in high use this year, it was recommended to decommission this tool, saving an estimated 40% of total TEL FSI facility water. Decommissioning the ORION 1 would also save 2.4 million standard cubic feet of nitrogen annually.

Install Flow Meters in Process Lab

Currently, there are flow meters distributed throughout the facility. However, there are no flow meters that show individual water usage for each tool. Tests using bucket catches and tank level tests showed that 23% of facility water from the process lab cannot be tracked and therefore is likely not vital to the process. It is recommended that TEL FSI install fifteen meters on the supply loop and the reclaim loop before and after each tool. Flow meters can track water within the process lab and identify future reduction opportunities.

LIQUID NITROGEN REDUCTION

Fix Compressed Gas Leaks

TEL FSI uses compressed gases in their process including nitrogen, argon, and compressed dry air. In order to check for leaks, an ultrasonic leak detector was used in the water room, sub fab, production floor, and process lab. Leaks were identified, recorded, and most have been fixed. Though most leaks were small, significant cost savings are associated with fixing these leaks. Fixing just the nitrogen leaks will result in saving 1.3 million standard cubic feet of nitrogen and $15,000 annually.

WASTE REDUCTION

A trash sort was conducted to analyze opportunities for waste reduction. Waste reduction recommendations were made from the sort which revealed that TEL FSI's trash is composed of 19% organic material, 12% clean room garb (hair bouffants, face masks, and boot covers), 13% plastic films, 10% single sort recycling, 2% miscellaneous recycling, and 44% true trash.

Add an Organics Recycling Stream

Many waste haulers offer organics recycling where organics are recycled into mulch. Adding an organics program would cost $73/month, but would reduce waste sent to the trash and increase the recycling rate by 5%. In order to create a successful organics recycling program, trash bins would need to be reorganized, signs would need to be placed, and an employee education program implemented.

Recycle Clean Room Garb

Clean room garb is used in both the process lab and production clean rooms. Using the VWR clean room garment recycling program, TEL FSI would use twelve pre-marked cardboard boxes for garment collection. Full pallets would be shipped and the items converted into plastic resin for more permanent reuse like piping or floor decking. When implemented, the program would cost TEL FSI $1,200 annually and increase the recycling percentage by 2%.

Expand Plastic Film Recycling

Currently there are plastic film recycling receptacles in the production floor for plastic bags, bubble wrap, and films. The bins are emptied and picked up by the Adult Training and Habilitation Center (ATHC) for recycling. The recommendation is to expand the program to the process lab and educate employees in affected areas to ensure that all plastic films are recycled. This recommendation has no cost and would increase the recycling rate by 3%.

Switch to Manual Shredding

TEL FSI shreds confidential documents through First Shred at a cost of $98 every eight weeks; however, First Shred was recently purchased by Shred It and cost increases are expected. Since TEL FSI has manual shredding machines on-site, they decided to switch to manual shredding. The shredded paper can be recycled through ATHC and picked up in their bi-weekly pick-up at no additional cost. While this recommendation does not improve the recycling rate, it will save $620 per year.

Discontinue Trash Compactor Lease

TEL FSI currently leases a trash compactor which is emptied about every six months and brought to the landfill. Ending the compactor lease and switching to a weekly trash pickup would save $6,250 annually.

Recommendation	Annual Reduction	Annual Savings	Status
Water conservation	11,900,00 gallons	$117,000	Implemented or in review
Nitrogen reduction	3,640,000 ft^3	$21,600	Implemented or partially implemented
Waste Reduction	19.2 tons	$4,800	Implemented or planned

Xcel Energy

Christine Lucky
Chemical Engineering
Washington University in St. Louis

Company Background

Xcel Energy is a major natural gas and electricity provider operating in eight states across the West and Midwest to power over 3.5 million homes and businesses. Xcel generates energy from a variety of sources, including coal, natural gas, nuclear, hydro, wind, and solar. They have undertaken multiple repowering projects, converting coal plants to combined cycle natural gas plants, and have invested heavily in solar and wind energy, leading the way in renewable power generation. Additionally, Xcel supports customer initiatives to reduce power demands by providing rebates for energy efficient changes.

"Working at Xcel Energy gave me a fantastic opportunity to translate my coursework to a practical, industrial engineering setting. This experience gave me a chance to gain technical knowledge, develop project management skills, and improve my communication abilities. Through this internship I was able to learn a lot about the power generation industry and reduction strategies that can be used in any field." ~CL

Project Background

Black Dog and Riverside, the sites of this project, are repowered coal facilities converted to natural gas combined cycle plants. Combined cycle generation plants require large amounts of high purity water for various process and auxiliary systems. The makeup water at both Riverside and Black Dog comes from onsite wells and is purified with reverse osmosis and demineralization systems, which were the focus of water conservation efforts at both plants. Leak detection, overall system analysis, and monitoring equipment improvements were used to find opportunities for water conservation, identify potential efficiency improvements, and optimize system performance.

Incentives To Change

Xcel Energy endeavors to decrease water usage and improve heat rate, creating more efficient processes, which reduce environmental impact and minimize operating costs. These improvements reduce the amount of water and natural gas required per MW-H, which lowers chemical consumption, decreases the carbon footprint, and improves profit margins. Finally, decreased flows reduce the demand put on treatment systems and pumps, resulting in extended unit lifetimes, reduced maintenance, and significant savings.

SOLUTIONS

Prevent Permeate Tank Drainage

The current design of the reverse osmosis 1 (RO 1) permeate tank and RO 2 buffer tank allow product to be siphoned out during standby conditions. It is recommended to eliminate this drainage by adding a vacuum break to the RO 1 concentrate drain line and relying on the overflow drain and PLC logic to control RO 2 tank levels. This change has been completed and will result in saving 730,500 gallons of water and $520 annually.

Increase Mixed Bed Throughput

Tuning the caustic injection before RO 2 and bypassing extra piping will improve pH control and reduce CO_2 levels in water going to the mixed beds. This will increase the throughput and reduce the number of offsite regenerations needed. This recommendation is in progress and will result in saving $16,000 annually.

Repair Leaking Valves

Both plants have a small number of leaking valves that account for most of the steam cycle water loss and significantly increase heat rate. It is recommended that Xcel repairs or replaces these valves at the next opportunity. When implemented, this recommendation will save 756,000 gallons of water, 9,300 MMBtu, and $29,000 annually.

Optimize Rotor Air Cooler Blowdown

It is recommended that Xcel connect and collect monitoring equipment data to track rotor air cooler water chemistry. Once monitoring capabilities are implemented, blowdown should be reduced as much as possible within Electrical Power Research Institute chemistry guidelines. This change is being tested and could result in saving as much as 21,800 gallons and $55 annually.

Optimize Water Softeners

Improvements to procedure adherence and increases in the time between softener regenerations is recommended. A leaking drain valve should also be repaired and a hardness monitor should be installed to ensure proper water quality. These measures will reduce the total number of regenerations. This recommendation is in progress and will save 545,800 gallons of water, 25,400 lbs. of salt, and $3,340 annually.

Reduce Auxiliary Water Use

Systems that are only used seasonally should be completely isolated when they are not in use. Isolating the building heating system from the steam system and closing it off from the makeup water header will significantly reduce summer water use, with no impact to operations. This change was completed and will result in saving over 4 million gallons of water and $9,720 annually.

Heat Rate Calculations

It is recommended that engineering staff complete a quarterly review of the heat rate calculations that were added to the control system to identify inefficiencies and develop projects. This recommendation is in progress with unknown environmental and cost savings.

Recommendation	Annual Reduction	Annual Savings	Status
Prevent Permeate Tank Drainage	730,500 gallons	$520	Complete
Increase Mixed Bed Throughput	6 regenerations	$16,000	In Progress
Repair Leaking Valves	756,000 gallons 9,300 MMBtu	$29,100	Recommended
Optimize RAC Blowdown	21,800 gallons	$55	Testing
Optimize Water Softeners	545,800 gallons 25,400 lbs salt	$3,340	In Progress
Reduce Auxiliary Water Use	4,032,000 gallons	$9,720	Completed
Heat Rate Calculations	Further Analysis Needed	Variable	In Progress

Minnesota Technical Assistance Program

Brandon Noel
Electrical Engineering
University of Minnesota Twin Cities

Project Background

MnTAP hired a student researcher in April 2016 to conduct a market study on the energy conservation and implementation potential for switching compressed air driven tools with electric tools. This two-year project is supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources through the Conservation Applied Research and Development program. The project includes literature review, data collection, stakeholder interviews, and state-wide opportunity potential analysis.

MnTAP
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Why Reduce Compressed Air?

Pneumatic tool use in manufacturing is extremely common, but most businesses do not realize the relative expense over electric-driven alternatives. The cost of running pneumatic tools is too often ignored by companies who could save thousands of dollars each year by considering other options. The potential for energy conservation and cost savings through replacement are significant.

Project Goals

The over-arching goal of the project is to help businesses make better decisions about their power tools. Specific project goals include:

- Estimating Minnesota's energy consumption by pneumatic tools. An estimate of Minnesota's potential cost savings will also be developed
- Interviewing Minnesota companies to help develop the statewide energy consumption estimate
- Creating a detailed methodology document that details how the estimate was developed
- Creating a guide for facilities to use as they consider a transition from compressed air to electric tools
- Generating a calculator tool to estimate energy, cost, payback times, and greenhouse gas savings from changing out pneumatic tools with electric
- Developing a technical reference manual specification for changing out pneumatic tools with electric tools.

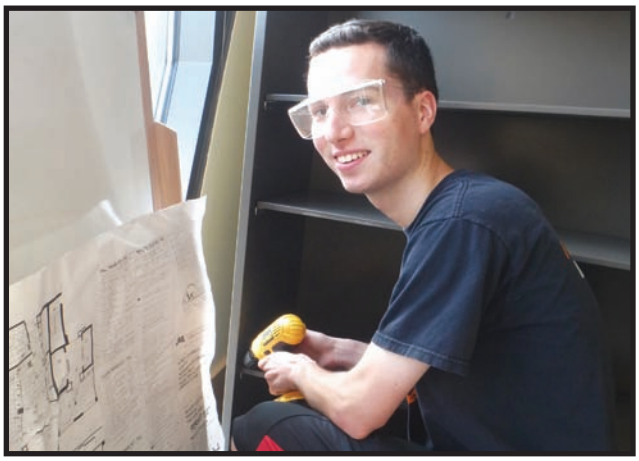
KEY RESEARCH FINDINGS

Statewide Estimate

Our preliminary results suggest that Minnesota manufacturers spend a combined $5 million in electricity powering their hand tools with compressed air annually, representing about 1% of their overall electric costs and about 42% of their overall compressed air usage. It is estimated that electric alternatives could cut costs by about 85%.

Savings Calculator

If pneumatic tools are replaced with direct electric-driven alternatives the payback can be reasonably quick. A typical facility could expect a simple payback period of around 6 months for corded tools and 11 months for cordless tools. The payback time depends on many factors but mainly on the efficiency of the compressor system.



Join the Intern Program in 2017

For Companies

Do you have a pollution prevention or energy efficiency project that you'd like to tackle, but are pressed for time? Would you like to help a science or engineering student advance their technical skills while providing them with a real-world opportunity to use their classroom knowledge? If so, consider hosting a MnTAP intern.

Your business may be able to address waste reduction as well as water and energy efficiency projects sooner and faster with the help of a MnTAP intern. An intern can make suggestions that improve efficiency, save money, reduce waste and material usage, or decrease your regulatory compliance burden. Also, an intern has the time and creativity to research alternative equipment, procedures, chemicals, and raw materials. As with all of MnTAP's projects, proprietary information at your facility is kept confidential during and after the intern project.

Company Benefits:

- A new set of eyes and dedicated time looking at your waste, water or energy project
- Project guidance by a MnTAP engineer or scientist
- A full report and presentation detailing the intern's work and next steps for your company
- MnTAP managing the recruiting, hiring, and training process

Now is the time to start thinking about developing a project for the summer of 2017. We anticipate supporting up to 15 projects next summer focusing on water conservation, energy efficiency, lean manufacturing, source reduction, and pollution prevention. Applications are being accepted from now until February 1, 2017 and will be reviewed upon receipt. Companies will be contacted by MnTAP technical staff within two weeks for additional project development and scoping. We request participating companies to contribute $3,000 to help support the intern program. These funds are used to offset project costs such as student compensation. Complete an online project proposal or call MnTAP today!

For Students

MnTAP is seeking junior-\ or senior-level college students to work on water conservation, energy efficiency, lean manufacturing, source reduction, and pollution prevention projects at companies in Minnesota. MnTAP anticipates funding up to 15 projects for the summer of 2017 in locations around the state. The projects are located at different companies and in a variety of industries.

Student Benefits:

- Positively affect a facility's environmental footprint
- Gain hands-on project management experience
- Use your classroom knowledge in a real-world setting
- Earn $15.00/hr and working 40 hours a week during the summer

"The intern recognized opportunities for improvements and acted on finding efficient and cost effective solutions to reduce our water usage. It has been a great opportunity to bring a new perspective to processes at the plants."

~Cheryl Erler, Environmental Analyst, Xcel Energy

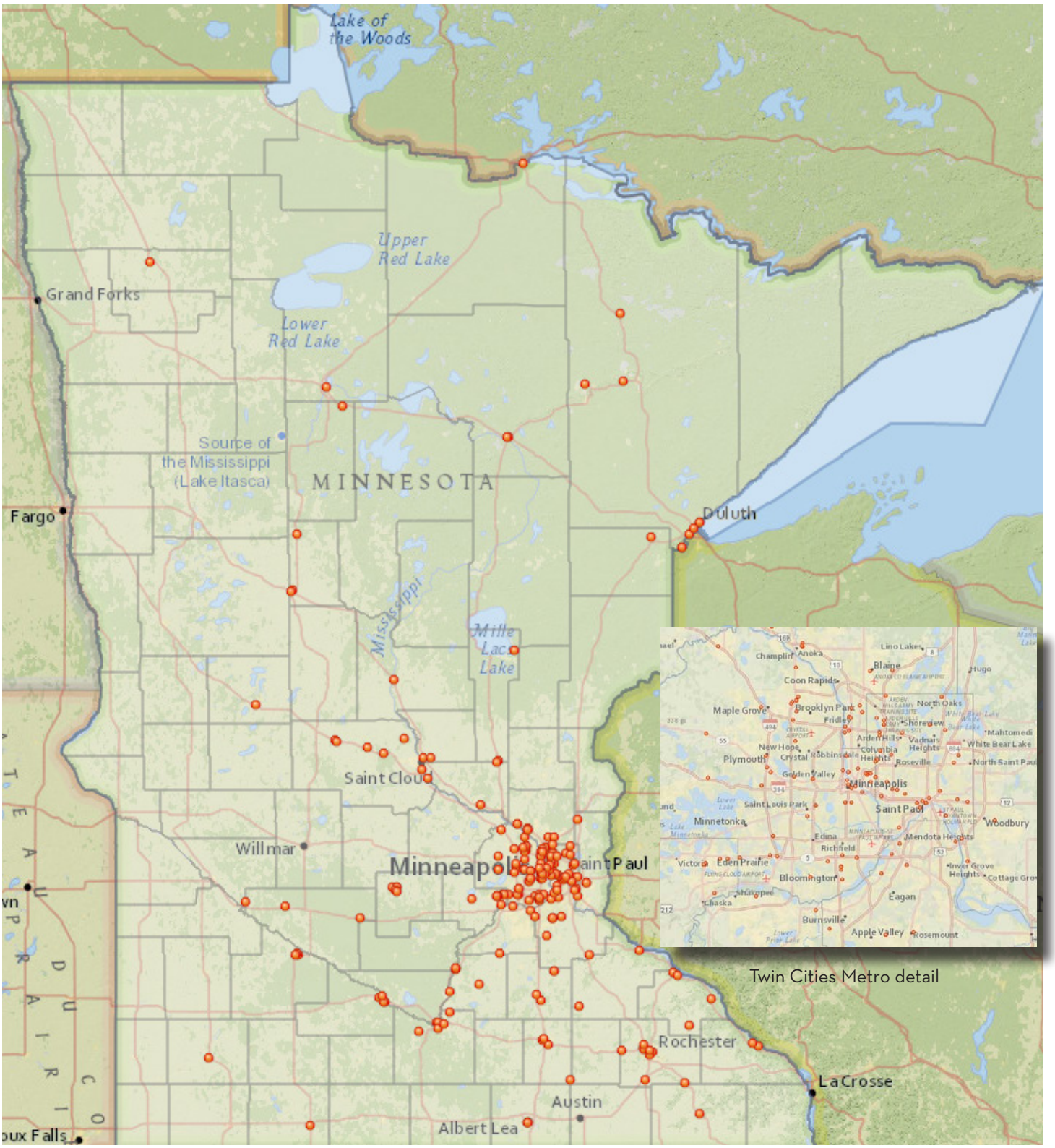
Applications are currently being accepted for summer 2017 internships. Interviews will begin in January of 2017 and selection of 2017 interns will continue until March 1 or until all positions are filled. Selected applicants will be matched to a project based on academic background and performance, relative experience, and technical skills. To apply for an internship, complete the online application form and submit it with your cover letter, resume, and unofficial transcript.

The University of Minnesota is an equal opportunity educator and employer.

Company intern proposals and student intern applications are available online now at:

www.mntap.umn.edu/intern

31 Years of MnTAP Intern Projects



Since 1985, the MnTAP Intern Program has helped over 240 Minnesota organizations identify resource reduction and waste prevention opportunities

About MnTAP

MnTAP is an outreach program at the University of Minnesota that helps Minnesota businesses develop and implement industry-tailored solutions that prevent pollution at the source, maximize efficient use of resources, reduce energy use, and reduce costs to improve public health and the environment.

MnTAP provides technical assistance tailored to each business. By reducing waste and increasing efficiency, businesses in Minnesota can save on disposal and raw material costs, decrease regulatory compliance burdens, and make working conditions safer for employees. Services outside the intern program include site visits, team facilitation and phone assistance.

MnTAP is funded by a pass-through grant from the Minnesota Pollution Control Agency's Resource Management and Assistance Division to the University of Minnesota School of Public Health, Division of Environmental Health Sciences and other grant and partner sources. MnTAP has no regulatory responsibilities or obligations and our work is confidential.

"TEL FSI, Inc. has participated in the MnTAP internship program twice and we have found the students and faculty that support them to be very knowledgeable and highly productive working on the improvements we have requested them to undertake. The internships support our green initiatives and support our overall corporate TEL parent company environmental policy, vision and goals."

~ John Walker, Vice President of Operations, TEL FSI, Inc.

For more information about the intern program or how to participate, please contact MnTAP Intern Coordinator Paul Pagel at 612.624.4638 or ppagel@umn.edu

MnTAP SOLUTIONS

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