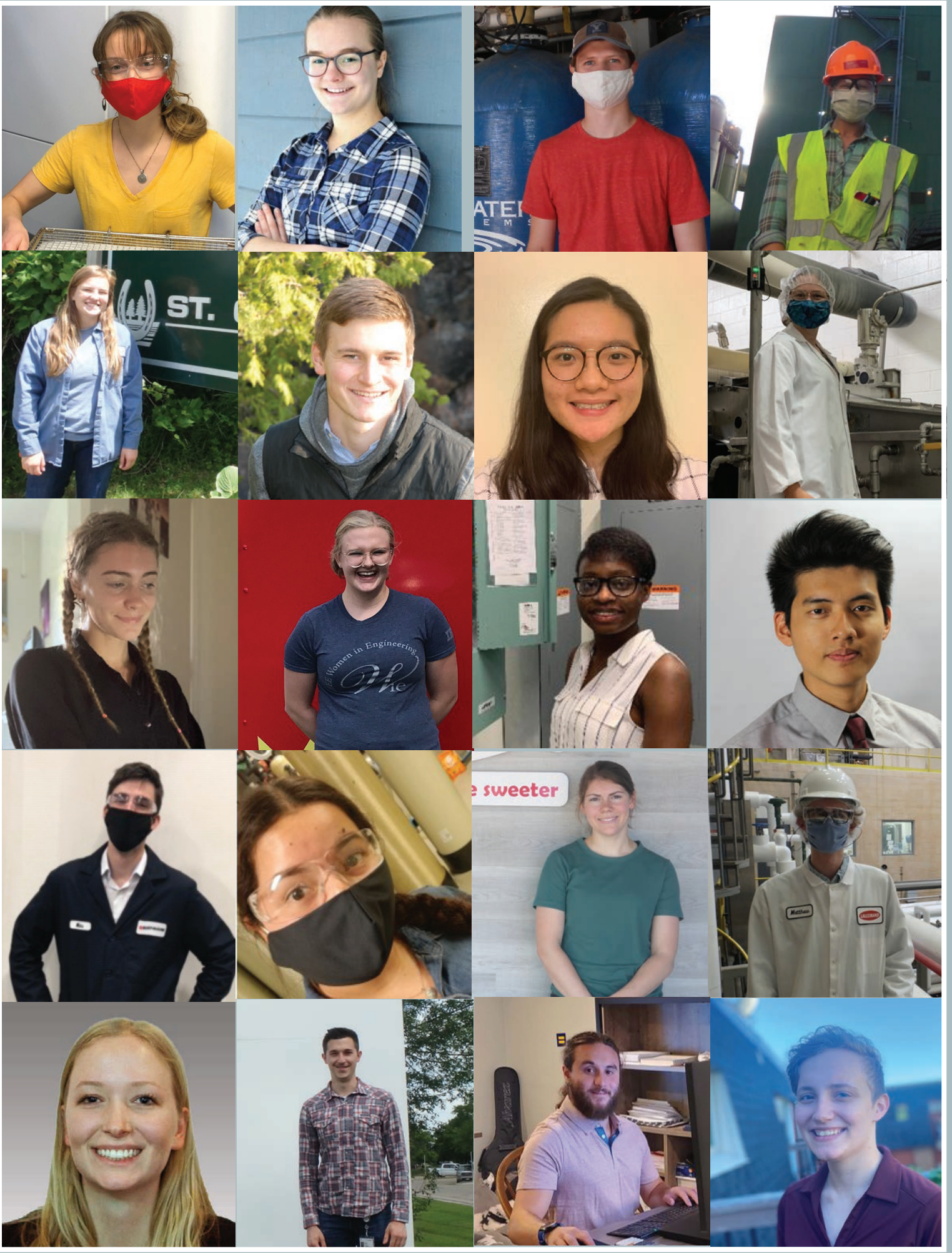
MnTAP

SOLUTIONS

2020 MnTAP Intern Program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Intern Projects

Project Focus Key Chemicals · Electricity/ Natural Gas · Water · Waste

MnTAP thanks our generous partners who make this vital work possible. Each of these organizations contributed financially to the intern program in 2020. Their support helps maintain our continuing pollution prevention, energy efficiency and water conservation work.

"Rising to the challenge of adapting its practices to a global pandemic, MnTAP seamlessly and creatively worked with five Metropolitan Council-funded interns to realize millions of gallons of water savings at industries across the Twin Cities metropolitan area. It's a triple-win, providing valuable experience to the student interns, increased efficiency for our local industries, and enhanced sustainability for our water supplies."

~Brian Davis, Senior Engineer
Metropolitan Council Environmental Services

"The Minnesota Department of Commerce supports the MnTAP Intern program. The program not only produces energy efficiency projects that benefit the people of Minnesota, but also supports the growth of future energy professionals."

~Mary Sue Lobenstein, Conservation Improvement Program Research & Development Program Administrator, Division of Energy Resources, Minnesota Department of Commerce

"Xcel Energy is proud to continue to support the MnTAP Intern program. Year after year, the student interns identify high quality energy saving projects that are implemented by our customers. Additionally, we (Xcel Energy) value the training and education that MnTAP provides to the next generation of energy efficiency and waste reduction specialists!"

~ Nicole Kessler
Xcel Energy Customer Solutions

"It's been exciting to see the array of creative solutions to nutrient reduction from these students. The wastewater sector has enormous responsibility to the environment and to human health, to meet nutrient reduction goals, and MnTAP and the students involved in these projects have added resources and support in creative ways to meet the goals of wastewater permittees."

~ Joel Peck, Municipal Liaison
Minnesota Pollution Control Agency

"I was so incredibly impressed by the tremendous work done by the intern program this year. The staff managing the largest group of summer interns the program has ever hosted while navigating through safety protocols and other demands placed by a worldwide pandemic is truly an amazing accomplishment. These students really delivered, providing recommendations that would save upwards of $3 million per year for the host companies and that had resulted in 30% of them being implemented by the end of the summer."

~ Mark Snyder, Pollution Prevention Coordinator
Minnesota Pollution Control Agency

"CenterPoint Energy takes pride in supporting the MnTAP internship program, which we have been doing for several years. The program allows students to grow into their profession by utilizing their skills in real-life projects with outstanding businesses throughout the state of MN. The experience we have each year with the MnTAP interns continues to be excellent. The program prepares students for a career in energy and engineering while providing our customers with a valuable service"

~ Todd H. Berreman
Director of Energy Efficiency, CenterPoint Energy

"Participation in the MnTAP Intern Program will help the Minnesota Department of Administration in its efforts to meet ambitious environmental sustainability goals by conserving water, improving energy efficiency, and reducing greenhouse gases at the State Capitol Complex. The intern's important work this summer expanded on past project successes while also identifying new areas of opportunity to reduce costs and improve environmental performance."

~ A. J. Van den Berghe, C.E.M., Energy Manager
Minnesota Department of Administration

2020 Intern-Proposed Solutions

Recommendation	Reduction	Cost Savings	Equivalents (annual)
Water Conservation	148,000,000 gallons	$360,000	Water for 6,500 Minneapolis residents
Waste	1,900,000 lbs	$320,000	Annual waste from 1,000 Minnesota residents
Chemicals	130,000 lbs	$100,000	More than 250 55-gallon drums
Electricity	27,000,000 kWh	$1,900,000	Electricity for 2,800+ Minnesota homes
Gas	190,000 therms	$70,000	CO_2 emissions from 200 passenger vehicles
Production Impacts	---	$1,500,000	---
Total Potential Cost Savings	**---**	**$4,250,000**	**---**

For more information and applications, contact Intern Coordinator Matt Domski at 612-624-5119, mdomski@umn.edu or at mntap.umn.edu/interns/business/howtoapply

Be Part of the 2021 Intern Program

A History of Success

For over 35 years, MnTAP has been coordinating an intern program that places highly qualified students in facilities for three months to focus on pollution prevention and energy efficiency solutions. The goal of the program is to provide benefits to companies and students while extending MnTAP services to businesses around the state.

Interns Have Far-Reaching Impact

The interns' impact reaches far beyond the walls of the facilities; many solutions identified during projects have been applied to other companies, increasing the impact of the program.

Companies Reap Rewards

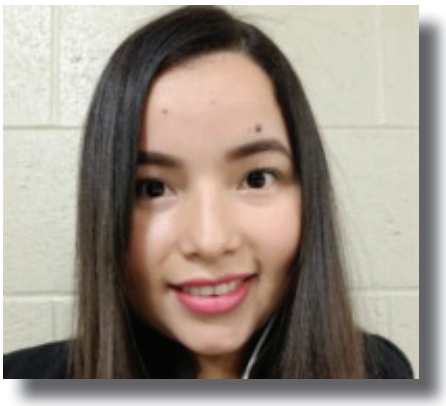
More than 350 companies have been served by the program. Interns have worked with industries such as hospitality, healthcare, manufacturing, and food processing. The bottom line is MnTAP intern projects result in solutions that positively impact a business and reduce its environmental footprint.

Sign Up Now

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?

Now is the time to start thinking about developing a project for next summer. Applications are accepted until **February, 2021**.

Abbott



Nahir K. Hurtado Mercado
Chemical Engineering
University of Minnesota Duluth

Company Background

Abbott is a multinational medical device and health care company with headquarters in Illinois, USA. Abbott has been helping people live their best lives for more than 130 years. The Woodridge site in Little Canada is part of the structural heart division in the medical devices area. The site is responsible for manufacturing mechanical heart valves, tissue heart valves, and stents. One of Abbott's most recent milestones is that their devices helped improve the lives of 2,000,000 patients in 2010.

"This internship has shaped me into a more environmentally responsible engineer by helping to conserve water and energy. It gave me the opportunity to use my in-class knowledge in a real work place." ~ NH

Project Background

Manufacturing medical devices involves process stages with relatively high water use demand. The Woodridge facility uses around 9.8 million gallons of water per year and has goals to minimize overall water consumption. From 2010 to 2019, Abbott has reduced its global water consumption by approximately 28%. The company continues to set goals in ordered to minimize water and energy consumption and waste generation. This project focused on identifying and minimizing areas of high water use and waste streams. This was achieved by analyzing and mapping process steps, identifying solutions for efficiency and creating action plans for the best solutions to minimize water & energy usage and waste.

Incentives to Change

Abbott maintains an on-going committment to protecting the environment and reducing the footprint of its business operations, including the protection of clean water resources around the world. Abbott has set a goal to reduce 30% of overall water consumption from 2010 to 2020. Through the work of a MnTAP intern, solutions identified at the Woodridge facility will contribute to achieving this ambitious and important goal.

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Reverse Osmosis (RO) System Optimization

Abbott uses a reverse osmosis (RO) system as a pretreatment step for the Deionization (DI) system. This reverse osmosis equipment can recover up to 75% of the water and a minimum of 96% Total Dissolved Solids (TDS) rejection. Although the system rejects 98.6% of impurities, it recovers 48% of the water, with the remaining 52% going straight to the sewer. There is an opportunity to increase the recovery percentage, which helps decrease energy and water consumption of the equipment.

"The MnTAP Intern Program provided the site with a focused effort to identify water reduction opportunities. Nahir's adaptability, enthusiasm and ability to gain support from staff was a great asset to the project. We appreciate all the work Nahir has provided and know that she will be successful in her future endeavors."

~ Mike Godfrey, EHS Manager

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Reusing RO Reject Water

Reusing the reverse osmosis reject water was found to be another opportunity to save water. Abbott can save from 25% to 40% of the water rejected from the reverse osmosis system if re-use is implemented. This reject water from the reverse osmosis system could be collected and sent to reclaim water tanks for use in the wet scrubbers.

Changing DI Water for Soft Water in the Fog Chamber

There are two horizontal wet scrubbers in the plant used to purify the exhaust from the reactors in order to release clean air. The particle growth system in one of the scrubbers uses DI water to help coalesce particles and obtain better filtration. The use of only DI water is not required for this process, because one of the scrubbers has operated for years using only softened water. Switching from DI water to soft water will conserve water and energy, since the DI water requires a 3-step purification process: softening, reverse osmosis, and finally, deionization.

Scrubber Filter Rinsing Time Optimization

In order to clean the air as much as possible, there are 4 filters in the scrubber with different mesh sizes, which the air passes through before it is released into the environment. The filters are rinsed on an interval of 15 minutes. Each nozzle runs for a specific fixed time even if no reactors are in use. There is a controller to manage how long they should run depending on the number of reactors running. Optimizing the rinsing times by using the controller was evaluated for its potential to minimize water usage. It was found that Abbott's Woodridge site was operating at set points below what the controller program recommended. Therefore, this change would not yield any water savings and was therefore not recommended.

Recommendation	Annual Reduction	Annual Savings	Status
RO system optimization	560,000 gallons 2,200 kWh	$4,400	Planning
Reusing RO wastewater	250,000 gallons	$1,850	Investigating
Changing DI water for soft water in fog chamber	575,000 gallons 26,400 kWh	$6,900	Under review
Rinse time optimization for scrubber filter	N/A	N/A	Not Recommended

MnTAP Advisor: Matt Domski, Waste Prevention Specialist

Albert Lea WWTP

Gabriel Pfeiffer
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

The Albert Lea Wastewater Treatment Plant (WWTP) is located in the City of Albert Lea in Freeborn County, MN. The plant serves a population of 18,203 along with industries such as food processing, metal plating, a biodiesel plant, an ethanol plant, and truck washing. In 2019, the facility treated a total of 9.5 million lbs. of Biological Oxygen Demand (BOD) (a quantitative measure of total organic matter), 123,000 lbs of ammonia nitrogen, and 132,000 lbs of phosphorus from these domestic and industrial sources.

"This summer I had the opportunity to learn about municipal wastewater treatment in a unique way. Being away from the facility pushed me to deepen my understanding of the processes in order to connect theoretical knowledge to experimental data. It was fun to collaborate from afar in order to learn the ins and outs of plant operations and obtain the data necessary to complete the project." ~ GP

Project Background

The plant was originally designed to treat for solids, organic matter, pathogens, organic nitrogen, and ammonia, and effectively treats for all these species at this time. More recently, other components of wastewater have been found to exert adverse effects on aquatic ecosystems, and the facility currently discharges these nutrients, particularly phosphate and nitrate, at concentrations in excess of 5 mg/L as P and 20 mg/L as N, respectively. Excess nitrogen and phosphorus in receiving waterbodies accelerates a process called eutrophication, which causes massive algal blooms, followed by the depletion of dissolved oxygen, and death of higher organisms such as fish. The objectives of this project were to explore methods by which the plant could reduce the concentrations of nitrogen and phosphorus in the effluent of the Albert Lea WWTP through Biological Nutrient Removal (BNR).

Incentives to Change

Investigating opportunities for Biological Nutrient Removal (BNR) at the Albert Lea WWTP offers an alternative to chemical addition that has the potential to not only save money on chemical purchases or plant upgrades, but also find savings due to reduced aeration requirements characteristic to BNR systems. In order to investigate these opportunities, a computer program called ASIM (Activated sludge SIMulation) was employed to model a variety of changes that could be implemented at the facility. The optimum changes with respect to impacts on the plant effluent as well as the feasibility of implementation were determined by analyzing results from ASIM. Evaluation of changes to facilitate BNR are timely, given that the plant is expected to receive a new permit imminently, which will most likely include a phosphorus limit of 1 mg/L. The plant is not currently equipped to treat phosphorus biologically down to this level, so either a multi-million dollar redesign or an annual addition of large amounts of ferric chloride or aluminum sulfate to chemically remove phosphorus would be required. The City estimates that a plant upgrade to achieve biological phosphorus removal would cost between $40-50 million dollars. Alternatively, the intern calculated that approximately $150,000 of ferric chloride would need to be applied annually in order to reduce phosphorus concentration in the effluent below 1 mg/L.

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Recommended Configuration Change

In order to facilitate biological nutrient removal, the current configuration of the tanks and clarifiers at the Albert Lea WWTP have to be re-arranged. The current secondary aeration basins must stop being aerated, and instead it is recommended that mechanical mixers be installed to provide the turbulence required to keep solids in suspension. This tank would function as an anaerobic/anoxic zone, allowing for the removal of nitrate and phosphorus. In addition, the current secondary clarifiers would also be equipped with mechanical mixers in order to keep solids in suspension. These clarifiers would then act as an extension of the anoxic/anaerobic zone formed in the proceeding tanks. The other tanks at the plant would be maintained as-is. The only other major modification would be the connection of the two return activated sludge lines to create one single-sludge system. Simulations of this configuration showed that two sequenced anoxic/anaerobic zones achieve 99% phosphorus and 90% nitrate removal from baseline simulations, all while keeping effluent ammonia concentrations under the most stringent permit limit of 1 mg/L.

The City of Albert Lea WWTP was pleased to have Gabriel as a MnTAP intern working with us this summer. This is our first year working with MnTAP and would participate again. He used computer modeling to help us better utilize nutrients. We hope to implement his suggestions to produce higher quality wastewater effluent by reducing phosphorus."

~ Brandon Huston, Plant Superintendent

Recommendation	Annual Reduction	Annual Savings	Status
Configuration Change	79,000 lbs of phosphorus 300,000 lbs of nitrogen 1,300,000 kWh	$98,000	Recommended

MnTAP Advisor: Josh Kirk, Associate Engineer

August Schell Brewing Co.

Mason Balster
Environmental Engineering
University of Minnesota Twin Cities

Company Background

August Schell Brewing Company was established in 1860, making it one of the oldest breweries in the United States. The brewery has 70 full time employees and produces about 120,000 barrels of beer and 20,000 barrels of root beer each year. With the purchase of Grain Belt Beer in 2002, it became the largest brewery in Minnesota.

"My summer with MnTAP at August Schell Brewing Company was awesome! I learned how to design an effective approach for many different engineering problems." ~ MB

Project Background

Leading up to this project the brewery has made several attempts to improve wastewater loading and water use efficiency. A previous MnTAP project, in 2011, made recommendations primarily around water conservation and energy savings. In 2013, the brewery started separating out spent yeast from the main waste stream and selling it to be used in animal feed. This process lasted until early 2017 when changes in commodity pricing lowered the value of yeast such that the brewery now had to pay to get the yeast off site. Faced with increasing sewer surcharges, the brewery decided it was time for another MnTAP project.

Incentives To Change

Schell's is interested in reducing their carbon footprint and includes this in their core value statement: "We are rooted in tradition, cultivated in innovation." Not only are these goals in sustainability good for the environment, but they are often good for business too. By reducing key characteristics of their wastewater stream, biological oxygen demand (BOD) and total suspended Solids (TSS), the company saw great potential for savings on wastewater surcharges. In addition, brewing is a water intensive process that can range from 7 barrels of water to make 1 barrel of beer to as low as 3-4 barrels of water per barrel of beer. As the brewery continues to grow, improving process efficiency is a top priority.

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Reducing Wastewater Loading

Two approaches were explored to reduce BOD and TSS in wastewater to eliminate strength charges. By incorporating a spiral brush filter from Digested Organics, the brewery would remove solids from the waste stream and dramatically reduce organic loading. It is estimated that the filter would remove 50% of BOD and up to 50% of total suspended solids (TSS). Alternatively, an anaerobic digestion treatment system developed by Purpose Energy would utilize bacteria to break down organic waste and produce renewable energy in the form of biogas. This system would reduce organic loading by 99%, removing 430,000 lbs of BOD, 240,000 lbs of TSS, and 4,000 lbs of phosphorus. In addition the system would generate 700,000 kWh of electricity. Between the savings on electricity and sewer surcharges, the brewery would see net savings of $190,000 annually.

Packaged Product Recycling

Currently packaged product is dumped to the drain in the event of over production or out of spec testing. The recommendation is to ship packaged products to E-Z Recycling where recyclable solids are separated from high strength liquids. Glass and aluminum are then recycled, while liquids are directed to either an ethanol plant or

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anaerobic digester for renewable energy production. This option would reduce BOD loading by 9,600 lbs per year. Between savings on labor and sewer surcharges, annual net savings would amount to $4,200.

Reduce Sample Cooling Water

Throughout an individual brew there are 4 samples taken. These samples have to be cooled from a temperature near the boiling point. Samples are poured into a jacketed container with cold water being pumped through the outer jacket at all times. The current process uses about 274,000 gallons of water a year. By adjusting the time the water runs to 15 minutes per sample, the brewery will save 200,000 gallons of water a year and $1,000 annually.

Greensand Filter Backwash Rate

Greensand filters are used every day on incoming city water in order to reduce iron and manganese concentration in the water, thus reducing water hardness. The greensand filters are on a schedule to recharge every night Monday through Friday. This recharge process ends up sending 1,600,000 gallons of water to the drain each year. By adjusting recharge frequency to a staggered schedule the brewery will save 550,000 gallons of water and $2,700 annually.

Non-Phosphorus Cleaners

The brewery utilizes phosphoric acid based cleaners in their day to day operations. Between two chemicals, Dairy Acid HD and Foam Sol E, 650 lbs of phosphorus is sent down the drain each year. Two phosphorus free alternatives from the brewery's same supplier were identified and investigated. While the alternatives for both products are more expensive based on face value, when phosphorus loading costs are incorporated this is not the case. By making the switch the brewery would eliminate all 650 lbs of phosphorus going to the drain and save $1,400 annually.

"Mason was a great addition to the Schells Brewery team. His energy and passion for continuous improvement brought new life to our sustainability efforts. We were very impressed with the improvements that Mason helped incorporate to the brewery's processes and the next steps he provided us to further our sustainability efforts. We would highly recommend other businesses invest in the MnTAP program."

~ Kyle Blair, Director of Operations

Recommendation	Annual Reduction	Annual Savings	Status
Digested organics side streaming	215,000 lb BOD and 96,000 lbs TSS	$48,000	Investigating
Purpose energy anaerobic digester	430,000 lb BOD, 240,000 lbs TSS, 4,000 lb phosphorus	$190,000	Recommended
Packaged waste to E-Z Recycling	9,600 lbs BOD	$4,200	Recommended
Adjust filter backwash frequency	550,000 gallons	$2,700	Investigating
Reduce sample cooling water	200,000 gallons	$1,000	Implemented
Switch to phos-free alternatives	650 lbs phosphorus	$1,400	Investigating

MnTAP Advisor: Michelle Gage, Engineer

Bosch

Aiden Kamber
Biological Engineering
University of Illinois at Urbana-Champaign

Company Background

Bosch is a multinational engineering and electronics company headquartered in Gerlingen, Germany, with over 125 locations worldwide. Bosch Automotive Service Solutions in Owatonna, MN, is one of the only sites in the US that manufactures tools required to service vehicles. With over 38,000 unique part designs and a total of 3000 tons of metal processed annually, Bosch is a high-variety, low-quantity manufacturer that has the capability to meet customer orders and specifications for tools for virtually any automobile on the market.

"I had a phenomenal experience working with MnTAP this summer delivering waste reduction solutions! I learned so much about manufacturing processes, corporate environments, and how to lead a project that has real impacts. I would highly recommend the internship to anybody looking to get hands-on experience by applying engineering concepts learned in the classroom to the real world – all while working directly with both MnTAP staff as well as the onsite supervisor." ~ AK

Project Background

Bosch Automotive Service Solutions has seen an increase in solid waste from 1500 tons in 2017 to over 2300 tons in 2019. Bosch Corporate has set a goal for the facility to maintain its waste volume at 2017 amounts even as yearly production increases.

The intern initially focused on opportunities to reduce scrap metal, which accounts for over 50% of solid waste at Bosch (note: scrap metal generated at the facility is recycled, but is still internally counted by Bosch as waste). It became evident that the most impactful changes to reduce metal waste would require significant time investment and capital to re-engineer part designs or create castings, which were outside the scope of the project.

The intern shifted attention to wooden pallet waste, which was one of the facility's top waste category by volume and had high potential for reduction. The intern investigated solutions to improve the storage and organization of pallets as they are used throughout the facility to facilitate a procedure for pallet reuse and reducing disposal volumes.

Incentives To Change

Bosch is strongly committed to its environmental and sustainability values, as well as a company-wide goal to be carbon neutral by 2020. While the Owatonna facility has already successfully diverted much of its waste from going to landfill, a part of the challenge for improving their waste numbers was in the high standards that Bosch has for waste management. Bosch considers outgoing disposal streams that are used for any purpose other than its original design as "waste," even if those streams are recycled. This project demonstrated the value of reuse as a waste management method.

"The projects that were implemented during the internship have already benefited our Bosch site, and have even been shared with other Bosch locations. Additional projects were recommended that will help us realize continued sustainability and cost reduction improvements in the future. We found this partnership with MnTAP to be really valuable for both the intern and the business, and we look forward to working together again."

~ Andrea Peterson, HSE Manager

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Follow New Pallet Sorting Procedure Using Installed Shelving Rack

One of the main challenges to reducing pallet waste that the intern identified was the lack of a standard procedure for reusing pallets. A waste dive of pallets revealed that a significant portion of the pallets were in reusable condition. The intern also observed that there was no convenient storage space available in this work area for reclaimed pallets.

After discussing the current situation with the intern supervisor and other Bosch staff, it was revealed that a shelving rack from another Bosch site could be brought in. The additional shelving space would solve the storage problem without the need for making an additional purchase. A best location was identified for the shelving unit, which tripled storage capacity for pallets in the area.

The intern also created signage as visual cues to indicate the new process as well as training materials in the form of a presentation and several illustrative diagrams. These were used by the facility to help communicate the new procedure to area managers, maintenance team members, and forklift operators. Ensuring that everyone was aware of the new initiative was essential for facilitating a regular flow of pallets from the newly created reclaim areas back to their main storage areas for reuse.

The impact of this new system was determined to be 25 tons of wood waste and $9,000 saved in reduced pallet purchasing costs, based on just an 8% reduction in pallet waste in the weeks immediately following implementation.

Contract with New Pallet Supplier

The intern identified a new pallet supplier company that offered superior prices for pallets, while also offering the ability to manage Bosch's current pallet waste stream. The primary advantage of this supplier is their capability to repair the broken pallets that they receive, rather than shredding the pallets as mulch. Reusing the wood to build new pallets allows for Bosch to reduce its pallet waste numbers by 95%. Working with this new supplier would allow Bosch to divert 245 tons of wood waste from being mulched while saving $26,400 on purchasing costs.

Optimize Fan Timers

Bosch has approximately 350 24-inch fans in their facility that are used for workstation comfort. The intern noticed that these fans were left on at the end of the shift when no workers were present. The intern measured the power draw for these fans to estimate the total energy usage, and interviewed Bosch associates to learn how frequently they were switched on. It was determined that if a two hour reduction on fans could be achieved, this would amount to approximately 26,200 kWh of energy and $2,800 saved.

Recommendation	Annual Reduction	Annual Savings	Status
Follow New Pallet Sorting Procedure Using Installed Shelving Rack	25 tons pallets	$9,000	Implemented
Contract With New Pallet Supplier/Recycler	245 tons pallet and wood waste	$26,400	Recommended
Optimize Fan Timers	26,200 kWh	$2,800	Recommended

MnTAP Advisor: Daniel Chang, Associate Engineer

Chemical and Waste Elimination

Elizabeth Jambor
Industrial and Systems Engineering
University of Minnesota Twin Cities

Organization Background

This manufacturer located in the Twin Cities Metro Area supplies components to OEMs in regulated industries across four continents. The company has about 800 employees in this location and focuses on assembly, machining, and grinding operations, as well as various design processes within their industry.

> *"The intern was very professional and productive. MnTAP's intern program is an outstanding program. I strongly recommend to tap into this resource if you have the opportunity."*
>
> *~ Fellow Scientist*

"This summer I have been able to experience the industry in a well-rounded manner that encompasses hands-on learning. I am very grateful for the opportunity to gain understanding in my career as well as industrial problem-solving skills." ~ EJ

Project Background

The purpose of this project is to facilitate the elimination of Trichlorethylene (TCE) and N-Propyl Bromide (nPB) from cleaning processes. TCE is a hazardous solvent which can cause cancer and other serious health effects. Although nPB is sometimes marketed as a safer alternative to TCE, nPB also poses worker safety concerns including nervous system damage. In 2019, 5,200 lbs of TCE and 800 lbs of nPB were used in cleaning processes. A new vacuum degreasing system is planned to replace both the TCE vapor degreaser and nPB systems and eliminate both hazardous chemicals from the facility's operations. The new machine will use a modified alcohol-based solvent. Opportunities to reduce Isopropyl Alcohol (IPA) used to clean surfaces in the manufacturing area were also investigated.

Incentives To Change

The current TCE and nPB processes work efficiently to clean parts, but also pose health and environmental risks. The company has been working proactively with MnTAP since May 2019 to eliminate these hazardous chemicals from their systems. In May 2020, the Minnesota legislature passed a ban on TCE that will become effective in June 2022. The new cleaning process will eliminate 6,000 lbs of hazardous chemicals and $13,100 in purchase and disposal cost annually. Optimizing cleaning cycles for different categories of parts will reduce waste and increase the capacity of the machine itself. There are also additional savings associated with the increased efficiency and productivity of the new machine. Reducing IPA usage represents an additional opportunity to lower air emissions, reduce waste, and save money.

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Optimize Cycle Times for the New Cleaning System

There are over 500 parts that currently go through the TCE process. These parts were categorized by their characteristics and tested in the new machine to identify optimal cycle times for different categories of parts. These cycle times vary from being the same length as the current TCE process or up to 4 minutes quicker. This designation of varying cycles for each part will increase machine capacity and efficiency. The new cleaning process will save 5,200 lbs of TCE and $10,700 per year.

Identify Single Fixture for nPB Parts in the New Cleaning System

A single fixture for the new cleaning system that can fit all parts currently cleaned in the nPB process was identified. The nPB process currently specifies various equipment based on the part. Implementation of a single fixture that will be able to fit all parts will allow different parts to be cleaned at the same time, eliminating partial cleaning batches and creating a more standardized and efficient process. Switching to the new cleaning system will save 800 lbs. of nPB and $2,400 per year.

Replace IPA Squeeze Bottles with Plunger Cans

In 2019, about 4,300 lbs of 70% IPA were purchased for surface cleaning at a cost of about $25,000. The IPA solution is currently held in squeeze bottles, where the quantity dispensed is reliant on the operator and therefore variable. Plunger cans allow dispensing of a small, consistent amount on a rag, with the excess liquid going back into the can. This will reduce variability and decrease usage across the facility.

Recommendation	Annual Reduction	Annual Savings	Status
Optimize cycle times	5,200 lbs TCE	$10,700	Implementing
Identify fixture for nPB parts	800 lbs nPB	$2,400	Implementing
Replace IPA squeeze bottles with plunger cans	TBD	TBD	Requires further study

MnTAP Advisor: Jane Paulson, Senior Engineer

Chemical Alternatives - TCE Elimination

Anja Savic
Industrial and Systems Engineering
University of Minnesota Twin Cities

Organization Background

This global outsource manufacturer supplies quality components to global OEMs. This location creates products for numerous different industries, all with the common goal of creating reliable and quality components. Primary operations are metal forming processes including stamping, drawing, and trimming.

"Working with MnTAP and this company this summer was an invaluable opportunity. It taught me many things, ranging from how a manufacturing floor runs to how Lean/ Six Sigma tools are used as solutions to real problems. This experience allowed for me to see how Industrial and Systems Engineering and sustainability are not mutually exclusive but rather go hand-in-hand. I'm very thankful for the experience I have had and for this company's commitment towards creating a safe and environmentally conscious facility!" ~ AS

Project Background

Over the past year, the company has been working with MnTAP to eliminate TCE in order to improve the safety and environmental sustainability of their processes. Trichloroethylene (TCE) is a hazardous solvent that is used for cleaning and degreasing for metal parts. An alternative cleaning process has been identified using a modified alcohol solvent and a vacuum degreaser. Plans are in place to eliminate TCE from all product value streams as quickly as possible in compliance with the Minnesota TCE ban which goes into effect in July 2022.

Incentives To Change

The installation of the new vacuum degreasers poses an opportunity to simultaneously address yield issues. This project worked to validate the effectiveness of the new machine while also determining whether supplemental cleaning steps are necessary. This will allow for the elimination of unnecessary processes, reducing chemical usage and related costs. This project focused on providing quality and a risk-based approach and centering safety and environmentally conscious decisions as priorities on the manufacturing floor.

"Anja did an excellent job working with the Engineering team at the site to help move the project ahead!"

~ Senior Engineering Manager

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Elimination of Mineral Spirit Pre-Wash

A manual pre-wash with mineral spirits was previously a part of the value stream in order to more effectively clean parts. However, with the effectiveness of the new vacuum degreaser, this step was found to be unnecessary. Since mineral spirits are not only flammable but also have a myriad of other potential negative side effects for workers, the environmental, health and safety benefits of removing mineral spirits from the cleaning system are significant. Additionally, as the mineral spirits are not reusable, eliminating them will save $2,400/year in replacement costs.

Replacement of TCE with Vacuum Degreaser

By altering production lines to use the vacuum degreaser instead of the TCE degreaser, around 15,000 lbs of TCE will be eliminated. Due to the proximity of the operators who load and unload parts, removing TCE has significant effect on operator health and safety. The new modified alcohol solvent has been determined to be a safer alternative to TCE while working effectively in cleaning products by targeting the removal of both polar and non-polar contaminants. Additionally, the vacuum degreaser is a closed loop system that continually separates the solvent from the contaminants through the use of a boiler, requiring only very small quantities of make-up solvent.

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Optimize Annealing

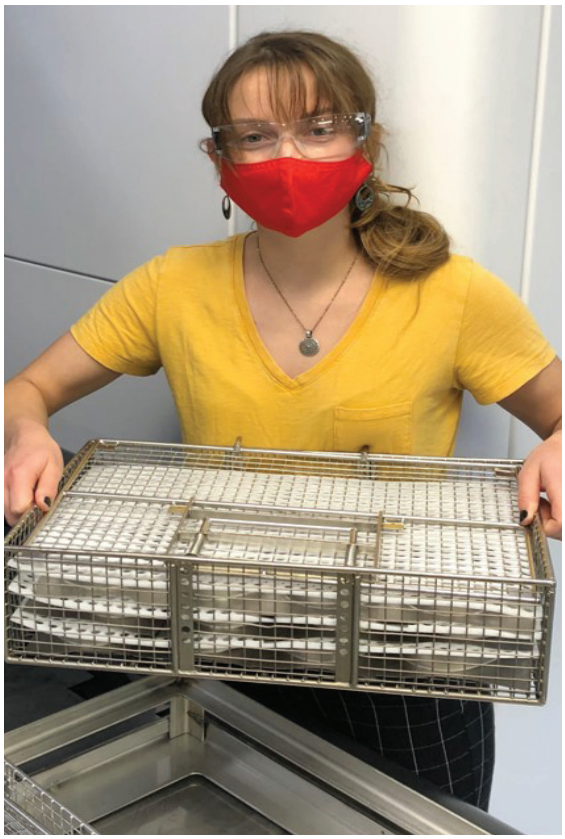
Past studies have been conducted that suggest changes to the current annealing processes could improve product quality. Through altering cleaning processes and optimizing annealing, we hope to reduce parts scrapped due to scoring by 35 lbs, saving $9,000 and improving lead times.

Removal of Washer

The majority of products are run through an aqueous cleaning step following the TCE degreaser. This step was thought to be essential to remove any contaminants that the TCE degreaser was unable to remove. However, due to the higher level of cleaning provided by the new degreaser, there is potential to reevaluate the necessity of this step. This may ultimately result in the removal of the aqueous washer system entirely from the facility, resulting in water, chemical, and labor savings.

Monitor Solvent Life and Effectiveness Through Dyne Testing

Although the manufacturer has stated that the modified alcohol solvent should never require replacement, its effective life has not been verified. Therefore, a dyne test was investigated to monitor alcohol purity and establish part cleanliness standards.



Recommendation	Annual Reduction	Annual Savings	Status
Elimination of mineral spirit pre-wash	2,100 lbs	$2,400	Recommended
Replacement of TCE with vacuum degreaser	15,000 lbs	$9,300+	Implementing
Optimize annealing	35 lbs titanium	$9,000	Recommended
Removal of washer	250,000 gallons RO water 150 lbs cleaner	$3,000	Requires further study
Monitor solvent life and effectiveness through dyne testing	4,800 lbs	$20,700	Requires further study

MnTAP Advisor: Jane Paulson, Senior Engineer

LifeCore Biomedical

Elisabeth King
Bioproducts & Biosystems Engineering
University of Minnesota Twin Cities

Organization Background

Lifecore Biomedical, LLC is a Minnesota based biopharmaceutical company that manufactures and supplies sodium hyaluronate in a variety of molecular weights and forms. The Chaska, MN location has two facilities, one for formulation and aseptic filling and the other for further packaging. The injectable grade sodium hyaluronate is used by multiple clients for applications in areas such as orthopedics and optometry. The company's mission is to provide high quality innovative product development and manufacturing solutions driven by their commitment to improving people's lives.

"This project was a great opportunity to practically apply my educational background in engineering and sustainability to make a positive impact at Lifecore Biomedical and on the environment. I learned so much about the biopharmaceutical industry while at Lifecore Biomedical from their remarkable employees. MnTAP provided valuable support and helped me to discover that I have what it takes to lead a project." ~ EK

Project Background

Based on recorded water data, Lifecore consumed around 46.5 million gallons of water during 2019. About half (47%) of this water is turned into Water for Injection (WFI) to be used in the production steps of the sodium hyaluronate products. The project consisted of two parts: mapping and identifying water intensive processes in the facility, and recommending and implementing water reduction strategies

Incentives To Change

Reducing water consumption can lead to financial savings related to not only incoming supply, but additional costs such as energy, sewer discharge, and permitting. Investigating water use practices and identifying opportunities for conservation could decrease demand for water and allow processes in the building to conduct work without delaying water intensive tasks. These water conservation opportunities, associated savings, and possible increase in production lead to monetary savings and increased longevity of existing equipment.

"Elisabeth investigated the solutions and proposed the equipment and processes to further investigate. The results were immediate savings of water and some potential projects for future implementation."

~ Kevin Mijal, Senior Facility Engineer

SOLUTIONS

Installing Flow Meters

An ultrasonic flow meter was used to estimate water use of four key unmetered processes. These measurements were compared to the amount of expected water consumption based on standard operating procedures (SOPs). Any water used over procedure volumes was assumed to be saved if meters where installed. Between the four tasks, it was found that approximately 1,800 gallons of water could be saved each week. It was recommended that at least 7 flow meters be installed in strategic locations

Adjustments to Standard Operating Procedures

Current water use SOPs require flow rates and times to be greater than or equal to a set quantity, but do not specify maximums. It was found that on average, an additional 30 gallons of water above the minimum is used per part rinse. A water conservation training section was created to encourage lower flow rates and times.

Another current SOP requires that sinks be left on at a constant low flow to keep the heat exchanger and pipe system sanitized with hot water. It was estimated that 7 to 9 sinks are left on at 0.04 gallons per minute, for a minimum of 4 to 6 hours every day. A sink sanitization

Solutions

study was conducted to test how long the sink ports stayed clean after sanitization. It was found that sinks stayed clean for up to 24 hours without flow. A report was created that suggests removing the documentation and practice of leaving sinks on, as well as adjusting heat exchanger sanitization to once every 24 hours.

Adjusting Condensate Coolers

Pure Steam Condensate in the facility must be cooled down to acceptable sanitary sewer discharge temperatures by condensate coolers, which is done by mixing in colder domestic water supply. It was determined that condensate coolers could be adjusted to allow a higher discharge temperature (approximately 140°F), which would use less domestic water. After adjustments, the combined initial flow rate of 12 gallons per minute (GPM) was decreased to 6.5 GPM. Half of the coolers did not respond to being adjusted and it was recommended that those be fixed to further decrease discharge.

Changing Filter Press Cloth

A filter press is used to collect the sodium hyaluronate for the majority of batches. The current filter press cloth vendor does not control for endotoxins (microbial control) in the manufacturing process. This leads to extensive cleaning of the filters and water use to dislodge potential endotoxins. If an alternative vendor was selected that did control for endotoxins in the manufacturing process, rinsing could potentially be cut in half and conserve approximately 2,300 gallons per use.

Updating/Replacing Reverse Osmosis System

The purification method used to create WFI includes a reverse osmosis system. About 32% of inlet water is rejected and discharged to surface water. The reject stream could be decreased by adding a second pass system, an electro-deionization unit, or replacing it entirely with water softeners and active carbon filters. If the discharge stream was to be eliminated, approximately 11 million gallons could be saved each year.

Recommendation	Annual Reduction	Annual Savings	Status
Install process water meters	55,000 gallons	$115,000	Recommended
Remove practice of leaving sinks on	60,000 gallons	$125,000	Implementing
Create water use training	300,000 gallons	$500,000	Implemented
Repair and adjust condensate cooler temperatures	3,000,000 gallons	$20,000	Implementing
Change filter press cloth type	70,000 gallons	$145,000	Recommended
Replace reverse osmosis system	11,000,000 gallons	$75,000	Recommended

MnTAP Advisors: Matt Domski, Waste Prevention Specialist; Taylor Borgfeldt, Pollution Prevention Specialist

Minnesota Specialty Yeast

Matthew Landauer
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

Minnesota Specialty Yeast (MSY) is a subsidiary of the Canadian company Lallemand and develops specialty yeast products for the food and agriculture industries. Their facility in Hutchinson, MN, uses a continuous fermentation process to produce 7.5 million tons of yeast cream per year.

"My MnTAP internship at MSY helped bridge the gap between academic theory and practical application. Collaborating with existing staff and bringing in engineering insights aided MSY in their pursuit of greener yeast production and rewarded me with in-depth discussion and firsthand troubleshooting at scale. My experiences at MSY give me an edge both in the classroom and in my career by exploring a dynamic industrial system." ~ ML

Project Background

MSY uses privately owned wells to supply water at up to 1,300 gallons per minute for cooling needs with additional process water supplemented from the City of Hutchinson. The facility typically discharges approximately 1.2 million gallons per day of well water to the Crow River. Wanting to preserve the longevity of their water supply while reducing their discharge output, MSY sought a MnTAP intern to help evaluate options to reduce cooling water usage. The facility was able to explore multiple alternative cooling options with support of the intern, who began by mapping out the water flow paths and heat loads of equipment throughout the facility.

In addition to water conservation, MSY wanted to decrease their phosphorus output by reevaluating their process SOPs. Phosphorus is a water pollutant that can be harmful to aquatic life in excess amounts and costly for wastewater treatment plants to remove. Phosphoric acid is used at Minnesota Specialty Yeast as a macronutrient for the yeast, as well as for pH regulation of their fermenters. The intern assessed the opportunity to reduce the phosphorus consumption and output and quantified the potential cost savings for the chemical reduction and sewer charges.

Incentives To Change

With environmental regulatory limits in wastewater effluent tightening in many locations across the state, both publicly owned treatment works (POTWs) and industrial businesses throughout Minnesota are closely monitoring phosphorus levels in waterways. This project built upon previous work MnTAP had done with MSY to explore opportunities for phosphorus reduction. Decreasing phosphorus loading would conserve phosphoric acid, reduce the treatment burden on the downstream Hutchinson POTW, and lower sanitary sewer charges.

MSY also sought for opportunities to conserve water usage and decrease demand on their wells. This would save on operation and maintenance costs, preserve the lifetime of the wells, and combat microbial growth in their aquifers. Additionally, lower water consumption would offer the facility the flexibility to meet any potential future permitting restrictions on water pumping or discharge limits.

"In addition to Matthew applying his knowledge and skills to the summer's projects, he learned business and manufacturing plant operations, process knowledge and capex planning. Plant personnel working with Matthew appreciated his dedication and what they learned from interacting with him. We will definitely be applying for the program again."
~ Scott Sederstrom, HSE Manager

Solutions

Optimize pH Procedure by Prioritizing Sulfuric Acid Usage

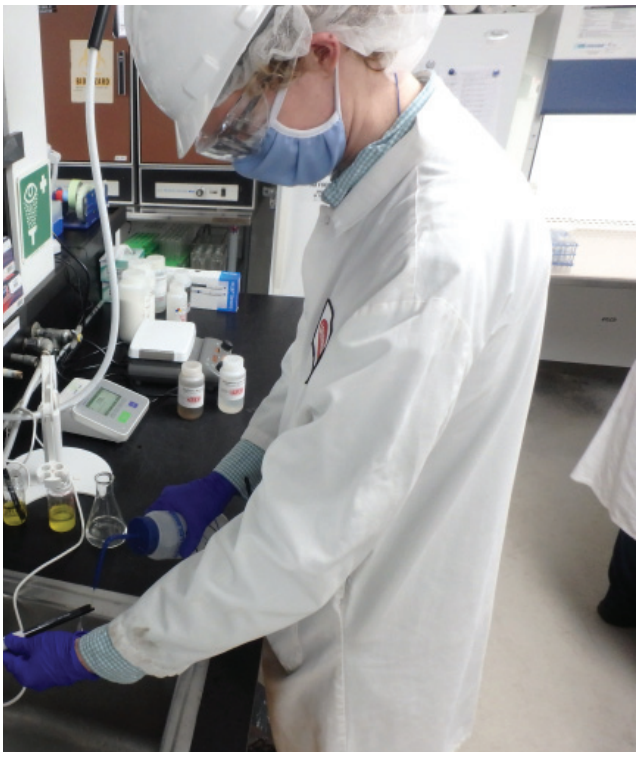
Part of the microbial treatment of the yeast cultures is to decrease the pH to conditions in which the yeast is resilient but other microbes are not. The intern found a consistent increase in phosphorus output to the sewer associated with this procedure. By conducting bench scale laboratory experiments to simulate the process, a new target pH and corresponding flow rate of sulfuric acid were determined. These new process conditions would allow pH in the fermenters to be driven by sulfuric acid rather than phosphoric acid. By updating their pH operating procedures, MSY would be able to reduce their phosphoric acid usage and prevent over half a ton of phosphorus per year from going to the sanitary sewer, netting them over $6,000 in savings from reduced chemical and sewer charges.

Use Cooling Tower to Cool Air Compressors

MSY cools their air compressors using a closed loop, which is in turn cooled by single-pass well water. The intern determined that a cooling tower could replace the single-pass well water stream with a recirculating loop, reducing the well water demand for this process by over 95%. This equates to over 100 million gallons of well water saved annually.

Use Spent Cooling Water for Boiler Make-up

The intern found an opportunity to reduce water consumption and reclaim process heat by proposing the reuse of softened well water from cooling processes for boiler make-up water. This well water, having been warmed from cooling the fermenters, could replace the colder city water currently used for the boiler feed and would require less energy to be heated to steam. This switch in water source could amount to 3,900 therms of energy and 1.3 million gallons of water saved. Overall cost savings from this recommendation is $7,500.



Recommendation	Annual Reduction	Annual Savings	Status
Optimize pH Procedure by Prioritizing Sulfuric Acid Usage	1,040 lbs Phosphorus	$6,400	Testing Planned
Use Cooling Tower to Cool Air Compressors	100 million gallons	$4,700	Further Investigation Needed
Use Spent Cooling Water for Boiler Make-up	3,900 therms 1.3 million gallons	$7,500	Recommended
Reduce Centrifuge Rinse Times	480,000 gallons	$4,300	Planned

MnTAP Advisor: Daniel Chang, Associate Engineer

MN Dept of Administration

Yaakov Knobloch
Mechanical Engineering
University of Minnesota Twin Cities

Organization Background

The Minnesota Department of Administration Facilities Management Division maintains and operates 22 state-owned buildings, including the State Capitol, plus 32 parking facilities, 25 monuments, and associated grounds for a total of 4.4 million square feet. The division also coordinates events on the Capitol Complex and assisted in the restoration of the State Capitol and Governor's Residence.

"This summer might've been spent away from home but it didn't feel that way. All of the MnTAP staff, especially my advisor, were there to support me in any way possible and I am extremely grateful to them. It has been an honor to work with the Department of Administration in finding ways to make the Capitol Complex more sustainable. The entire staff were open and very helpful in supporting new ideas and I'm incredibly thankful for all their help and support. I feel like I helped make a difference at the Capitol Complex and gained an out of classroom experience that you couldn't find anywhere else." ~ YK

Project Background

The focus of this project was to find ways to conserve energy and water. There were four main processes focused on in this project. Lighting retrofits, irrigation water optimization, bathroom flush valve retrofits, and air compressor savings opportunities were all analyzed as part of this project.

Incentives To Change

The Department of Administration is committed to running the government buildings in the most sustainable ways possible. There is an Executive order issued by Governor Tim Walz; Executive Order 19-27, "Directing State Government to Conserve Energy and Water and Reduce Waste to Save Money," which describes how the Department of Administration will work on making the government more sustainable. There are six sustainability goals the Minnesota State Government would like to reach with this Executive Order, and this project helps with two of those goals directly: to reduce energy consumption by 30% by 2027 and to reduce water consumption by 15% by 2025 relative to an adjusted 2017 baseline. Reductions in energy use will help with a third goal of reducing greenhouse gas emissions by 30% relative to a 2005 calculated baseline.

SOLUTIONS

Lighting Retrofits, Fluorescents to LEDs

LED lights use less energy and give off more light than older, fluorescent style lights. The LED lamps in this project draw anywhere between 7W and 16.5W, depending on the length of the lamp, while the fluorescent lamps draw 25W to 32W. Therefore, there are cost and energy conservation opportunities by replacing the fluorescent lamps with LEDs. With, rebates through Xcel Energy, resulting payback periods for lighting projects in the various buildings in this project range from 1-2 years, making these LED retrofits not only more efficient, but extremely cost effective.

Irrigation Optimization, Reduce Water Use with Seasonal Adjust Dials

The Capitol Complex is a high profile area with many events and much foot traffic. Therefore, it is important to the teams maintaining the lawns that they are sufficiently watered to stay green and healthy.

In researching historical weather data near the Twin Cities Metro Area, the team found that average rainfall for the Capital Complex is 0.9" per week. General best practices

suggest that lawns require a total of 1" of water per week. Therefore, irrigation systems should provide 0.1" of water per week during the irrigation season.

Irrigation meter water bills were used to calculate the amount of irrigation water currently being used. This was then compared to the 0.1" per week that should be required on average over the summer. The calculations found that some zones were already receiving very close to the recommended 0.1" per week, while other zones had opportunity to turn back on irrigation water use. Seasonal adjust dials on irrigation systems allow irrigation managers to easily turn back zone irrigation times using just one percentage based dial. Calculations were completed for each zone to identify the ideal amount to turn back that dial for each zone to meet the average 0.1" per week lawn needs. The irrigation team is planning to start slowly turning back these dials to approach the theoretical water requirements while observing the impact of the changes on the lawns in order to optimize water use for Capital Complex irrigation.

Retrofitting Bathroom Flush Valves

For tankless toilets, flush valves regulate how much water is dispensed every time the toilet is flushed, thereby controlling the water used per flush. Flush valves vary from allowing 1.28 gallons per flush (GPF) to 3.5 gallons per flush, depending on the type. The EPA recommends that commercial toilets have flush valves that at most use 1.6 GPF.

Current flush valves in the Capital Complex are estimated to be using roughly 2.5 gallons per flush. The Capitol Complex has thousands of workers and visitors that use their facilities every day, which means there are many flushes per year. This project suggests retrofitting these to meet the EPA standard of 1.6 GPF, which throughout the 10 Capital Complex buildings assessed will save an estimated 2.88 million gallons of water annually.

Replacing Current Air Compressor

In the Transportation Building, an air compressor is used for multiple different systems, including fire suppression and life support operations. Previously, compressed air was also used to pneumatically control variable air volume climate control systems. Then those systems were updated to electronically controlled systems, compressed air demand became smaller. The type of modulating load/unload air compressor studied in this project operates less efficiently at smaller loads, so this portion of the project served to find the savings potential associated with upgrading to a smaller air compressor that could handle this smaller load more efficiently.

Additionally, in order to keep water out of the air lines, there are three timed air drains throughout the piping which collect condensate water and at a set interval open to release the water from the system. When purging on a timer, the purge time does not exactly match the time needed to drain condensate. Usually, the purge time is longer, resulting in compressed air leaking through the purge opening. Because compressing air requires energy, purging air in this way is a source of energy loss in the system. An alternative to timed drains are no-loss drains, which use a float valve which opens and closes based on condensate levels instead of on a timer, saving energy by ensuring that air is not lost through the condensate purging process.

Recommendation	Annual Reduction	Annual Savings	Status
Retrofit fluorescent fixtures with LED lamps in six buildings	900,000 KWh	$81,000	In Progress
Use seasonal adjust dials for irrigation water conservation	6,900,000 gallons	$30,000	In Progress
Retrofit the toilet and urinal flush valves with new diaphragms	2,500,000 gallons	$30,000	Recommended
Install start-stop air compressors and zero loss drains in one building	17,000 KWh	$2,000	Recommended

MnTAP Advisor: Jon Vanyo, Engineer

Bethany Mestelle
Environmental Science, Policy and Management
University of Minnesota Twin Cities

Company Background

The Metropolitan Council is the policy-making body, planning agency, and provider of essential services for the Twin Cities metropolitan region. Their mission is to foster efficient and economic growth for a prosperous region. Metropolitan Council Environmental Services (MCES) is tasked with managing water and wastewater within this region, including water supply planning. MCES and MnTAP have been collaborating on industrial water efficiency projects in the metropolitan region since 2012.

"Being able to work with MnTAP this summer gave me the opportunity to apply the knowledge I have acquired in the classroom to real-world scenarios. Being able to manage my own project, with the expertise and assistance of the MnTAP staff, was an incredible experience, as few undergraduate internships allow students to learn and explore the field in this way." ~ BM

Project Background

Industrial water use is an important component of the total water use across Minnesota and within the metro area. Past intern and technical assistance projects have indicated there are often significant opportunities available for reducing the water intensity at industrial facilities. MCES and MnTAP are interested in determining if additional guidance on industrial water efficiency opportunities can be provided to industrial water users by analyzing past project impacts. Because MnTAP assistance is industry-tailored and unique to each company served, the recommendations may not be generalizable to every industry; recommendations vary by industry, scale, and scope. This project analyzed a set of 341 water conservation recommendations made by MnTAP between 2015 and 2020 with the overarching goal of identifying recommendations that consistently yield water conservation opportunities both across and within various industry sectors.

"It has been a great opportunity to have an Intern review the past water efficiency recommendations. Compiling, classifying and evaluating these recommendations is an important first step to creating resources that will help motivate water conservation across many industries."
~ Laura M. Babcock, Director

SOLUTIONS

Water Use Areas

The way water is used within industrial facilities is diverse. Process water use recommendations are most numerous. Approximately 2/3 of the analyzed recommendations are related to processes with 75% of them categorized within six main process water use areas: ingredient, conveyance, sanitation, steam generation, heating, and cooling. Recommendations regarding domestic water use and irrigation comprise approximately 1/3 of the water recommendations, and should be considered areas of substantial water conservation. Recommendations made for irrigation and domestic purposes often have low implementation costs, short payback periods and can be applied across a variety of industries and at businesses.

Water Use Classification

A literature review was conducted to understand what is currently known about industrial water use and to inform processes used to organize the MnTAP water efficiency data set for analysis. This data has been classified by type of recommendation, the water use area and by industry sector based on NAICS classifications.

Solutions

Recommendation	Description
Maintain	Repair equipment to run as originally intended
Manage	Perform the same operation in a more efficient way
Modify	Change the way water is used throughout the system

Process modifications yield the highest savings, both in terms of water conservation and economic savings. This can be seen across industries and manufacturing subsectors. These changes may be more cost and labor intensive, which could contribute to their lower implementation rate. Maintenance recommendations have a higher rate of implementation, despite having smaller savings associated with each recommendation. Maintenance recommendations often involve repairs and can easily be rolled into ongoing site maintenance activities which allows for needed resources to be assigned for implementation. Management recommendations tend to be automation or measurement related and have lower savings per recommendation than modifications, yet have higher implementation rates.

High Volume Recommendations

This analysis identified water efficiency recommendations that are statistically higher volume than most recommendations. Process modifications comprised 50% of these high volume recommendations compared with 36% of overall recommendations. Modifications tend to have large water conservation values, since they are large-scale changes to a process. Of the high volume recommendations, 83% are directly related to water use within industrial processes. The percent of high volume recommendations that have been implemented is 43%, higher than the 34% implementation rate for mid-range recommendations. This suggests that while modification recommendations may be more involved than management recommendations, many businesses see value in implementation.

High Value Recommendations

There are water efficiency recommendations that are statistically higher value than most recommendations. The overall implementation rate for high value recommendations is 48%, which is higher than the implementation rate for mid-value recommendations at 34%. There is additional waste or energy savings in 39% of the high value recommendations compared with 20% of the mid-value recommendations. The cost savings from co-benefits of waste and energy reduction increase the economic value of a water efficiency recommendation, and may increase the likelihood that a recommendation be implemented. Identifying co-benefits from a water process change and including them in the overall project justification may increase implementation potential.

Type of Recommendation	Number of Recommendations	Implemented Recommendations	Total Proposed Reduction (gal)	Actual Reduction (gal)
Process	233	97	580,000,000	150,000,000
Domestic	54	18	25,000,000	7,700,000
Irrigation	55	7	61,000,000	18,000,000
Maintain	33	16	40,000,000	7,400,000
Manage	189	68	170,000,000	68,000,000
Modify	113	35	420,000,000	73,000,000

MnTAP Advisor: Alaina Ryberg, Web Designer and Information Specialist

NW MN Wastewater Ponds

Ella Carlson
Bioproducts and Biosystems Engineering
University of Minnesota Twin Cities

Organization Background

Founded in 1978, the Minnesota Rural Water Association (MRWA) is a non-profit organization that provides technical assistance to and trains personnel at small municipal and non-municipal systems, rural water districts, and wastewater districts with populations less than 10,000. They offer professional services in several areas, including state and federal regulations, fiscal management, system operation and maintenance, source water protections, and more. The Minnesota Pollution Control Agency (MPCA) is the leading organization that monitors environmental quality and enforces environment regulations in the state of Minnesota. Both MRWA and MPCA are partnered with MnTAP to identify nutrient removal solutions for wastewater ponds across Minnesota.

Jerald Lim
Chemical Engineering
University of Minnesota Twin Cities

Project Background

Funded through a grant by the Legislative Citizen Commission on Minnesota Resources (LCCMR), the goal of the partnership of MnTAP, MRWA, and MPCA is to work with cities in optimizing the removal of nitrogen and phosphorus from their wastewater. Doing so involves analyzing current operations of their wastewater pond systems, researching best practices, calculating potential improvements, suggesting operational changes, and promoting the implementation of these low-cost solutions. The scope of this project encompasses the wastewater treatment ponds in the cities of Roseau, Warroad, Breckenridge, and Karlstad. Ella Carlson and Jerald Lim were the MnTAP interns leading the analysis with these pond sites. Ella took lead on the Breckenridge and Karlstad assessments while Jerald led the projects with Roseau and Warroad.

Incentives To Change

Nutrients in water, namely nitrogen and phosphorus, which come from agriculture, industry, or domestic households pose a serious threat to the health of aquatic environments. With an overabundance of these nutrients, algae are able to grow rapidly in local and international bodies of water. The excessive algal biomass consumes most of the oxygen in the water, leading to the depletion of oxygen and the subsequent death of aquatic animal and plant life in these ecosystems. In order to prevent these negative effects from occurring, the MPCA has placed limits on the phosphorus discharge in the effluents of wastewater ponds.

Solutions

Flow Pattern

Altering the way water flows through a wastewater pond can help immensely in increasing the hydraulic retention time (HRT) and maximizing the depth of water. As the amount of time water stays in the pond system increases, the treatment time increases, leading to better nutrient removal and cleaner discharge water. The overall goal is to keep the wastewater ponds as full as possible over the course of the year, ensuring that as much of the total pond volume as possible is actually being used for treatment time.

Inflow and Infiltration

Inflow and infiltration (I&I) refers to the unintentional flow of storm water into the sanitary sewer system. It leads to ineffective use of the available volume in a pond, since storm water does not need to be treated but still takes up space, and reduces overall treatment time. Reducing inflow and infiltration by performing dye tests, resealing manhole covers, and inspecting private properties would serve to improve system hydraulic retention time.

Waterfowl Prevention

Waterfowl, such as geese, contribute heavily to nutrient levels in these ponds in the form of fecal loading. Because waterfowl migration periods tend to align with wastewater pond discharge windows, and waterfowl like to use secondary, polishing ponds, slug loads of nutrients from waterfowl may have adverse impacts on effluent nutrient concentrations. Deterring geese from landing on the ponds during migration periods and deterring nesting at the ponds can lead to a direct decrease in nutrient levels. The use coyote cutouts and other decoys are suggested as options worth testing to reduce direct waterfowl nutrient loading into the ponds.

Chemical Phosphorus Removal

Chemical addition is a common method of addressing phosphorus and is recommended only if lower effluent levels cannot be achieved using the other solutions provided in this report. A cost analysis for four chemicals, ferric chloride, aluminum sulfate, Phoslock, and RE300, was compiled. From this, both ferric chloride and aluminum sulfate were found to be the most cost effective options at this time. In order to reduce costs associated with the use of a boat or mixer to add chemicals, gravitational addition of ferric chloride solution to the transfer structures between the primary and secondary ponds as water is being transferred was identified as a lower cost option, utilizing the natural mixing of the transfer process to distribute the chemical into the water.

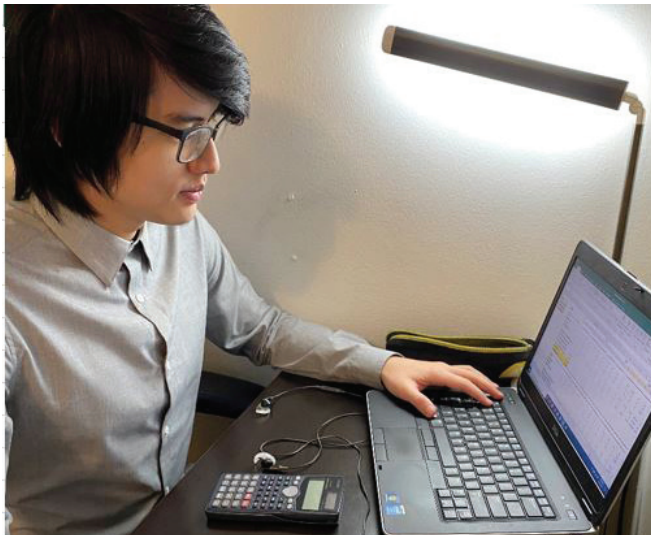
> "It has been great working with such talented professional and educated interns with the U of M MnTAP. The perspective and talents of the Interns brings confidence and success to the LCCMR wastewater pond optimization project"
>
> *~ Frank Stuemke, Minnesota Rural Water Association*

> "MnTAP interns provide site specific recommendations to operators for nutrient reduction at their wastewater facility."
>
> *~ Tim Hagemeier, Minnesota Rural Water Association*

NW MN Wastewater Ponds

Table 1: Roseau Opportunities

Recommendation	Annual Reduction	Annual Savings	Status
Increase Hydraulic Retention Time	160 lbs P	$0	Recommended
Use Coyote Decoys or Similar to Reduce Waterfowl Loading	1550 lbs P 5700 lbs N	$0	Recommended
Add Ferric Chloride as Chemical Phosphorus Treatment	600 lbs P	$0	Recommended
Increase Hydraulic Retention Time by Reducing Inflow and Infiltration	180 lbs P	$0	Recommended



"I think the biggest thing that I gained is the idea of a client-centered approach. We are always thinking about how to best present information that is relevant to the client, what recommendations make sense for their site, what concerns could they potentially have. My ultimate hope is that I've provided some value to all stakeholders involved in my project. This includes the MnTAP wastewater team, any future interns that may be working on similar projects, the MPCA, and of course my project sites. And finally, I really see myself continuing to work in sustainability for the long term." ~ JL

Table 2: Warroad Opportunities

Recommendation	Annual Reduction	Annual Savings	Status
Increase Hydraulic Retention Time	280 lbs P	$0	Recommended
Use Coyote Decoys or Similar to Reduce Waterfowl Loading	1400 lbs P 5000 lbs N	$0	Recommended
Add Ferric Chloride as Chemical Phosphorus Treatment	2600 lbs P	$0	Recommended
Increase Hydraulic Retention Time by Reducing Inflow and Infiltration	370 lbs P	$0	Recommended

MnTAP Advisor: Jon Vanyo, Engineer

Solutions

Table 3: Karlstad Opportunities

Recommendation	Annual Reduction	Annual Savings	Status
Increase Hydraulic Retention Time	100 lbs P	$0	Recommended
Use Coyote Decoys or Similar to Reduce Waterfowl Loading	100 lbs P 350 lbs N	$0	Recommended
Add Aluminum Sulfate as Chemical Phosphorus Treatment	70 lbs P	$0	Recommended
Increase Hydraulic Retention Time by Reducing Inflow and Infiltration	75 lbs P	$0	Recommended

My experience working with the Breckenridge and Karlstad Wastewater Treatment Ponds this summer was very beneficial to me as an engineering student with a concentration in the environment and sustainability. When I started this internship, I didn't know much about wastewater treatment but was very excited to be introduced to the field, and I learned so much by just jumping right into my project. Though I had to complete this internship remotely, I still gained valuable insight into how to complete an industry project and truly enjoyed my experience ~ EC

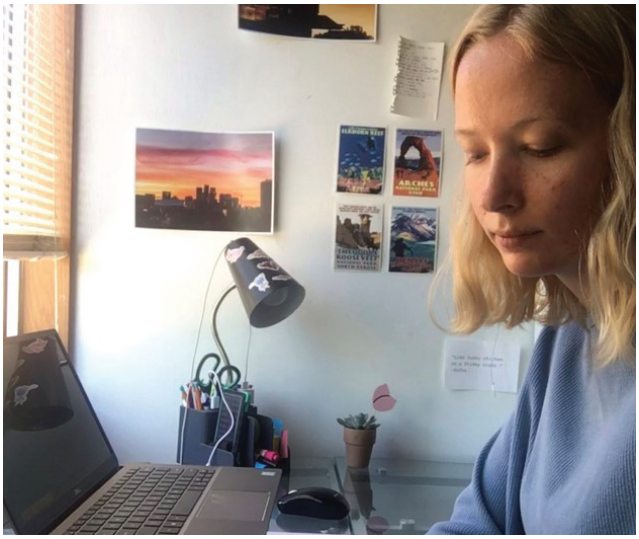


Table 4: Breckenridge Opportunities

Recommendation	Annual Reduction	Annual Savings	Status
Increase Hydraulic Retention Time	560 lbs P	$0	Recommended
Use Coyote Decoys or Similar to Reduce Waterfowl Loading	250 lbs P 940 lbs N	$0	Recommended
Add Aluminum Sulfate as Chemical Phosphorus Treatment	270 lbs P	$0	Recommended
Increase Hydraulic Retention Time by Reducing Inflow and Infiltration	1900 lbs P	$0	Recommended

MnTAP Advisor: Jon Vanyo, Engineer

Old Dutch Foods

Madison Best
Bioproducts & Biosystems Engineering
University of Minnesota Twin Cities

Company Background

Old Dutch Foods is a snack food manufacturing company located throughout the upper Midwest and Canada. The Roseville, MN facility produces multiple varieties of potato chips while the St. Anthony, MN facility produces corn chips and popcorn. These facilities process raw materials such as field potatoes and dent corn into valuable products, package, and distribute them to customers.

"Our intern was extremely focused and results orientated. She identified several items that we will be implementing in the near future. There is always opportunity and room for improvement in every process, so by having our MnTAP intern dedicating their time analyzing them good things happen." ~ Bob Erkkila, Plant Manager

"Working as an Intern at Old Dutch was a great opportunity for me to gain experience working in a food manufacturing environment. Seeing what goes into the implementation of sustainable solutions on such a large scale was a beneficial experience, and I was able to learn a lot about the intersection of engineering, business and sustainability. The internship greatly influenced my choice to pursue a future career in which I can utilize my engineering and communication skills to influence manufacturing practices."~ MB

Project Background

Old Dutch consumes approximately 35 million gallons of water per year at its Roseville location and 20 million gallons of water at its St. Anthony location. A major goal of the project was to identify and quantify the water intensive steps in production and identify opportunities for reduction or reuse. Recommendations were developed based on these findings to lower overall water usage.

Incentives To Change

Over the past several years, the company has noticed increasing water usage and operational costs at its Roseville location which is a primary motivator for water reduction. The cost of water at the St. Anthony location is the primary motivation for reductions at this facility. Old Dutch understands the importance of making investments that will benefit not only the company but also the environment in the long run.

SOLUTIONS

Add Valve on Washer Pump

Water is continuously supplied to the washer as potatoes pass through, but the water is not completely turned off between potato unloading shifts. A valve can be installed on the potato washer to eliminate unnecessary water use when potatoes are not being unloaded. This can lead to 460,000 gallons of water and $1,800 in savings every year.

Replace Potato Washer Nozzles

There are currently 17 high-pressure nozzles used to wash incoming potatoes and 9 use a higher flow rate than the others (2.3 gpm instead of 1.5 gpm). By exchanging these nozzles for ones of lower capacity, 600,000 gallons of water can be saved every year along with $2,000.

Install Variable Frequency Drive on Washer pump

A reciprocating pump moves water to the washer and is operating at full capacity. Lowering the motor speed by 35% with a VFD can lower pump water use by 950,000 gallons and electricity use by 37,000 kWh every year. These savings have a $5,000 yearly financial benefit.

Solutions

Recycle Water to Peeler

Both fresh water and recycled water from the recovery station are used to spray potatoes. By adding a new spray bar supplied with recycled water, the fresh water spray bar can be replaced. This will allow 890,000 gallons to be conserved, saving $3,600 annually.

Eliminate Freshwater Fryer Hose

A hose was discovered supplying fresh water to clean a pan on one of the fryers. By eliminating this hose and replacing it with a hose that uses recycled water instead, 3,000,000 gallons and $12,000 will be saved every year.

Add Locking Valve and Increase Recycled Water Use at Fryer

The water used to wash the potato slices before frying can be reduced by 50% by installing a locking valve on the freshwater supply and supplementing with recycled water. These two actions would save 3,750,000 gallons and $16,000 per year.

Add Hydrocyclones to Water Recycling System

An additional 1,250,000 gallons of water can be saved by installing filters (hydrocyclones) to the fryer sprayer effluent. This will reduce the starch content in the water so more recycled water can be used to replace fresh water, saving an additional $4,000 every year.

Automate Water Recycling System

By accurately changing the amount of recycled water that is processed and sent to various parts of the facility, more recycled water will be utilized, reducing the incoming freshwater stream. These updates could save 3,000,000 gallons of water and $29,000 annually.

Install Centrifuge at St. Anthony Location

A water recycling system can be implemented at Happy's by installing a disk stack centrifuge to clean wastewater. By removing a majority of dissolved solids and testing for the proper levels of contaminants water can be recycled to wash and soak corn to reduce fresh water use by 5,000,000 gallons leading to a cost savings of $100,000 annually.

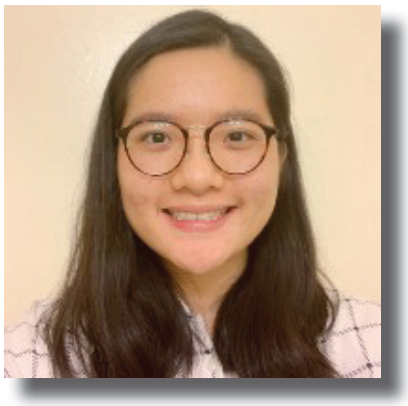
Replace Nozzles at St. Anthony Location

The water used to wash corn after soaking can be reduced by switching to low flow nozzles. The current nozzle flow rate is 1.4 gpm but a 0.85 gpm model also exists and can be used instead. Lower capacity nozzles have the potential to save 750,000 gallons and $15,000 per year.

Recommendation	Annual Reduction	Annual Savings	Status
Add valve on washer pump	460,000 gallons	$1,800	Planned
Replace potato washer nozzles	600,000 gallons	$2,000	Investigating
Install variable frequency drive on washer pump	950,000 gallons 37,000 kWh	$5,000	Recommended
Recycle water to peeler	890,000 gallons	$3,600	Recommended
Eliminate freshwater fryer hose	3,000,000 gallons	$12,000	Implemented
Add locking valve and increase recycled water use at fryer	3,750,000 gallons	$15,000	Implementing
Add hydrocyclones to water recycling system	1,250,000 gallons	$4,000	Recommended
Automate water recycling system	3,000,000 gallons	$29,000	Recommended
Install centrifuge at St. Anthony location	5,000,000 gallons	$100,000	Recommended
Replace nozzles at St. Anthony location	750,000 gallons	$15,000	Recommended

MnTAP Advisor: Brent Vizanko, Associate Engineer

Otsego West WWTF



Ingrid Chan, M.S.
Civil Engineering
University of Minnesota Twin Cities

Organization Background

The West Otsego Wastewater Treatment Facility is one of two municipal wastewater treatment facilities operated by the City of Otsego. The facilities were constructed in 2005-2006, collecting domestic wastewater from the surrounding area, serving approximately 2,000 households. The Otsego West facility is an activated sludge process receiving 0.4 million gallons (MG) of wastewater daily.

"It was a fruitful experience working with the West Otsego Wastewater Treatment Facility. I have developed a deeper understanding of resource conservation and wastewater treatment. It's amazing to see all the possibilities we discovered in the project and I am very grateful for this wonderful opportunity." ~ IC

Project Background

The project was conducted to explore the opportunity for greater energy, chemical, and operational efficiencies at the Otsego West Wastewater Treatment Facility. The objectives were to save cost on chemicals used in nutrient removal, protect local waters, and save energy through operational modification. These objectives were targeted by exploring the implementation of biological nutrient removal (BNR) at the site. The facility was designed for nutrient removal considerations however was challenged with current conditions requiring supplemental chemical additions.

Incentives To Change

The Otsego West facility is currently permitted to release phosphorus in their effluent at an average concentration no greater than 1.0 mg/L, and they meet this limit through application of approximately 15 gallons of ferric chloride solution per day. While this process provides sufficient treatment for phosphorus, purchase of ferric chloride is a continuous operational cost for the plant. In addition, iron salts are a safety hazard (the material is highly corrosive), they also consume alkalinity, and can stain UV bulbs, which reduces disinfection efficiency, and increases the energy demand of the system. In addition, while the facility does not currently have an effluent limit on nitrate, nitrogen compounds are known to exert deleterious effect on receiving water bodies, including far downstream in the Gulf of Mexico.

"[The] MnTAP internship program is a great resource! Guidance is provided by an Associate Engineer; technical resources are used throughout the process and the intern puts it all together. Ingrid made it easy, providing cost saving options to improve facility nutrient removal magnifying environmental benefits."

- Kurt Neidermeier, Utility Manager

Solutions

External Carbon Source Addition

Through use of the computer modeling software ASIM (Activated sludge SIMulation), it was found that the wastewater facility was limited in its ability to perform effective treatment for nitrate and phosphorus by the low amount of raw organic material in the influent. This organic material, often quantified as BOD (Biological Oxygen Demand), is an essential ingredient for the biological removal mechanisms of nitrate and phosphorus. Further simulations with the modeling software illustrated that a continuous addition of carbonaceous material to supplement the influent of the plant could facilitate effective biological phosphorus and nitrogen removal using the plant's existing infrastructure.

Construction of a New Anoxic Tank

Another potential change that was evaluated with ASIM was the construction of a new tank to serve as an anoxic zone, immediately preceding the oxidation ditches. This was found to be an alternative to external carbon source addition, and that the new tank would need to be at least 270,000 gallons in order to achieve the same effluent nitrate and phosphorus concentrations that were predicted with the external carbon source addition. This finding was informative in that it illustrated an alternative approach to facilitating biological nutrient removal; however, the construction of a new tank was deemed to be too expensive.

Increase Frequency of Gravity Belt Thickener Operation

At the beginning of summer 2020, the Gravity Belt Thickener (GBT) was operated twice per week at the Otsego West facility. The GBT serves to reduce the volume of sludge prior to digestion and storage. The supernatant generated from the process is sent back to the first tank in the facility. This supernatant stream was found to have a very high concentration of nitrate and phosphorus. During the summer, at the recommendation of the intern, GBT operation was increased from twice per week to five times per week. Tests on the supernatant before and after this operational change showed a 90% reduction in phosphorus and a 61% reduction in nitrate concentration in the supernatant attributed to the increased operation. This change will result in less nutrient content returning to the head of the facility, as well as a more enriched biosolids that will perform better as a fertilizer when land applied.

Recommendation		Annual Reduction	Annual Savings	Status
1a	External carbon source addition	40,000 lbs. Ferric Chloride 10,000 lbs Phosphate P 6,300 lbs Nitrate N	$13,000 from ferric chloride application	Recommended
1b	Construction of new anoxic tank		TBD	Not Recommended
2	Increase frequency of Gravity Belt Thickener operation	700 lbs Phosphate P 1,500 lbs Nitrate N	TBD	Implemented

MnTAP Advisor: Josh Kirk, Associate Engineer

Pearson's Candy

Lydia DeBuhr
Mechanical Engineering
University of Northwestern - St. Paul

Company Background

Pearson's Candy is a Minnesota candy company founded in 1909 and residing in its current building since 1959. Pearson's makes the Salted Nut Roll, Bit-O-Honey, Mint Patties, Nut Goodie, and BUN candies.

"This summer I left behind dust and grease for starch and chocolate, gaining hands on experience at Pearson's Candy Company. From installing valves, testing paint, and making maps to running calculations, writing an RFP, and leading consultants around the facility, I was given the freedom to take charge on a variety projects while being provided with the resources and help that I needed to succeed." ~ LD

Project Background

Many additions and alterations have been made to the building in the sixty years Pearson's has occupied it. The age of the building and much of its equipment allows for many opportunities to conserve energy through updating and maintaining current equipment. More thorough documentation of the HVAC system was desired in order to heat and cool the building more thoroughly and efficiently.

Incentives To Change

An energy assessment was recently performed for Pearson's offering Xcel Energy rebates for many energy saving projects along with additional Turn Key Incentives on many of the projects. In order to claim these benefits, projects must be implemented within 12 months of the energy assessment. Additionally, the St. Paul Port Authority Trillion BTU program is available to help finance energy saving projects such as these.

SOLUTIONS

Turn off Lights on Weekends

Because the building is staffed approximately 20 hours per day, the majority of the lights are never turned off. However, there is no staff in the facility on weekends allowing for the possibility of significant lighting reduction over that time. With the age of the building, turning off the lights is not a straightforward task as the locations of many switches and their functions are unknown. This led to a search for switches which were then numbered and documented with location and function and added to a map dictating an efficient route to follow to reach each indicated switch.

Reduce Compressed Air Leakage

Compressed air is used to some extent in most of the candy making equipment. This means there are a large number of joints with much potential for leakage. When there is no production in progress, compressed air leaks can be heard throughout the production floor. Leaks can be reduced by better sealing joints, patching or replacing hoses with holes, and adding shutoff valves to equipment that has open exhaust lines.

Solutions

Insulate Shared Walls Between Heated and Cooled Spaces

Tank rooms are maintained at between 100°F and 120°F while the production floor is kept approximately 65°F to 75°F. In several places, these two areas share walls and doors which are not thoroughly insulated leading to undesired heat transfer through the wall affecting both areas. Thermal insulating paint was recommended as a simple, cost effective method to improve insulation without taking up extra space in these crowded areas. After testing, it was determined that this paint did not create a statistically significant difference in either interior or exterior wall temperature so more traditional methods of insulating should be investigated.

Reuse Air Scrubber Wastewater in Liquid Sugar Batches

Water used by the kitchen air scrubber can be used in liquid sugar batches rather than going down the drain. As long as the piping meets food grade standards the only contaminate to the water is sugar from the air, which will not harm the liquid sugar batches as they are boiled.

"We believed that we had potential to upgrade our 40-year old HVAC equipment and generate significant energy savings and cost reductions, but we never seemed to have time to untangle the nest of details in that system. Lydia literally walked, crawled and climbed into every dark and hidden corner to track down each piece of the hodge-podge system that included over 100 various heaters, air handlers, fans and blowers. With her efforts and excellent details we were able to receive engineering proposals for a system re-design that will reduce our site-wide energy usage by 30% at half the capital cost of replacing each individual piece. She did such a great job that we hired her into a permanent role here at Pearson Candy. We're looking forward to implementing the solutions she identified and seeing what else she is able to help us achieve"

~ Alex Allen, VP of Operations

Recommendation	Annual Reduction	Annual Savings	Status
Shut off lights on weekends	86,000 kWh	$9,000	Implemented
Upgrade plant and office lighting to LEDs	180,000 kWh	$16,000	Recommended
Install occupancy sensing light switches	13,000 kWh	$1,400	Tentatively recommended
Reduce compressed air leakage	220,000 kWh	$24,000	Implementing
Upgrade HVAC system	890,000 kWh	$79,800	In Progress
Reuse air scrubber wastewater in liquid sugar batches	47,000 gallons	$1,500	Recommended
Thermal insulating paint	N/A	N/A	Not Recommended

MnTAP Advisor: Jane Paulson, Senior Engineer

Post Consumer Brands

Natalia Kaliszewski
Mechanical Engineering
University of Minnesota Twin Cities

Company Background

Post Consumer Brands' Malt-O-Meal facility in Northfield, MN is the largest ready-to-eat cereal manufacturing plant in the United States. Multiple production lines utilize steam as part of the manufacturing process of cereal and compressed air to operate multiple variations of production equipment.

"I learned a great deal about project management and manufacturing processes through my work with Post Consumer Brands this summer. I am thankful to MnTAP for providing the unique opportunity to make a difference in Post's energy use and I feel that my project will make a lasting positive impact for my company and the environment" ~ NK

Project Background

After an outside contractor completed an energy of assessment of the Northfield site, Post was still looking for more detail for a potential boiler system upgrade. Thus, the focus of this project was on improving the energy efficiency of the boilers and compressed air system, which included comparing different options for boiler system operation and replacement. In addition to energy and cost savings, there is an incentive to produce electricity on-site due to power reliability concerns.

Incentives To Change

A large amount of steam and compressed air is used in the cereal making process, which makes boiler and air compressor efficiency two top priorities for Post. Adding to this is the occurrence of power outages caused by storms, that add expense, wasted product, and additional work for employees. Post could benefit from generating their own on-site electricity to improve reliability and reduce operating costs.

"Our MnTAP intern Talia, came in and became part of the Post Consumer Brands family. She dove right in and collected numerous hours of research to assist us with improving our energy efficiency capabilities. With her dedicated focus on energy conservation it didn't take her long to identify several areas where we can start saving immediately. We will continue to learn from the information she provided and grow into the future supporting the efforts of energy efficiency and conservation."

- Jason Haugen, Engineer, Facilities,

Solutions

Install High-Efficiency Fire Tube Boilers

The current water tube boilers at Post Consumer Brands are reaching the end of their life. By replacing these boilers with high-efficiency fire tube boilers, Post would save 190,000 therms and $132,000 per year, and gain a faster reaction time to steam load changes in the facility.

Install High-Efficiency Water Tube Boilers

In the case that Post wants to keep all of their boiler types the same, high-efficiency water tube boilers could also provide savings to the facility. Water tube boilers would tie into the current boiler system well and have a faster startup time as compared to fire tube boilers. This option would save 44,000 therms and $82,000 per year in gas and maintenance savings.

Install a 1 MW Topping Cycle Combined Heat and Power (CHP) System

Due to the facility's grid reliability concerns, installing a cogeneration system could provide several benefits. By implementing a gas turbine as well as high-efficiency boilers, Post could save $967,000 annually from reduced gas use, maintenance, and continuous operation without power outage interruptions.

Identify and Repair Leaks in Bag House Compressed Air Lines

The air filtration systems in the plant are difficult to visually or audibly check for leaks because the leaks often occur inside the bag house and the ambient noise of the plant covers the sound of the leaks. By installing a flow monitor at the inlet to each bag house's compressed air line, the leaks could be identified and fixed. This would save the company $967,000 per year, assuming 7 leaks are found and repaired.

Recommendation	Annual Reduction	Annual Savings	Status
Replace boilers 1 and 2 with fire tube boilers	190,000 Therms	$132,000	Recommended
Replace boilers 1 and 2 with high-efficiency water tube models	44,000 Therms	$82,000	Recommended
1nstall a topping cycle combined heat and power system	900,000 kWh 190,000 Therms	$892,000	Recommended
Identify and repair leaks in bag house compressed air lines	12,000,000 kWh	$967,000	Recommended

MnTAP Advisor: Brent Vizanko, Associate Engineer

Rust-Oleum

Mika Rodrigues
Chemical Engineering & Chemistry
University of Minnesota Twin Cities

Company Background

Rust-Oleum is a consumer brand under RPM International focused on producing surface coatings for many applications. The company was founded in 1921 on rust resistant paints for boats, the company's product line now includes paints, adhesives, coatings, cleaning solutions, grout, sealers, and more. The Brooklyn Park facility, that was the focus of the MnTAP project, works primarily in concrete coatings which are sold to contractors and distributed to big box stores like Menards, The Home Depot, and Lowe's.

"My project was a wonderful mix of lab research and process and equipment improvement that always kept me engaged and let me work with many different people." ~ MR

Project Background

The primary directive of the project was to reduce the hazardous waste generation of the facility. The main target for reduction was methyl ethyl ketone, otherwise known as MEK or butanone, a low cost, highly effective solvent used in many industrial cleaning operations. In 2019, the facility used 35,000 lbs of MEK and generated 98,000 lbs of hazardous waste as a result of its cleaning operations. MEK was used for cleaning production tanks that range from 30 to 600 gallons. MEK has many drawbacks. Despite being removed from the EPA's list of hazardous air pollutants in 2005, MEK is a highly flammable VOC (volatile organic compound) and requires the use of a respirator.

Notable Solvents

MEK	Methyl Ethyl Ketone
DBE	Dibasic Ester
TOU	2, 5, 7, 10-Tetraoxaundecane
DMC	Dimethyl Carbonate

Incentives To Change

Currently, the facility is considered a large quantity generator of hazardous waste by the county and state. With that status comes inspections and fees as well as the additional cost of disposing of the hazardous waste. Changing to a non-hazardous cleaning solvent would reduce the hazardous waste generated at the facility and allow reclassification as a small quantity generator. This change would make a safer environment for the operators cleaning the tanks. A change in cleaning solvent could allow production flow improvements and more efficient use of equipment. This includes the ability to move the tank cleaning process to an area that does not require equipment rated for flammable environments such as forklifts.

"The MnTAP program helped Rust-Oleum achieve one of our core objectives for our fiscal year: finding an opportunity to clean our tanks/totes in a safer, more environmental friendly and cheaper way. It was a challenging problem, but one Mika worked hard on and provided solutions that were implemented. We couldn't have been happier with the MnTAP program, from selection of intern to relationship with their staff."

~ Steve Pisca, Plant Manager

Solutions

Use DBE and TOU as Solvents for Tank Cleaning

TOU and DBE are both non-hazardous cleaners. This means that it is safer to use, and operators will no longer be required to wear a respirator while using it. TOU was more effective than MEK on the hardest to clean products in the facility, meaning less solvent can be used when cleaning the really tough products. DBE was not as effective as MEK or TOU, however it is a low cost non-hazardous alternative to MEK which can be used effectively on the easier to clean products. Eliminating the flammable MEK, the tank cleaning process can be moved from the flammable production area. This frees up space for production and allows for more low-cost equipment options as tools would not need to be non-sparking.

Use Refillable Solvent Sprayer

A refillable sprayer was purchased to apply solvents when cleaning tanks. The sprayer is easily pressurized with compressed air. The sprayer was tested with both TOU and DBE to clean production tanks. Each test used less material compared to the previous method of splashing the sides of the tank with cups filled with solvent and did not add noticeable time or effort to the process. Solvent usage in trials was reduced by more than 75%. This suggestion has been implemented.

Use DMC and TOU in the Lab

Use of alternative solvents in the lab will improve worker comfort and safety. DMC has lower health hazards than MEK and had similar performance during tests. DMC is not an irritant, has lower odor and a higher flashpoint than MEK. DMC retains the ability to flash off, meaning that no residue is left of the equipment.

TOU was found to perform similarly to MEK in the equipment cleaning dip tanks. Dip tanks are used to rinse or soak equipment. TOU has a much lower evaporation rate and would not need to be refilled as frequently. This also reduces the quantity of flammable liquid present in lab workstations.

Automated Tank Washer

Dedicated tank washing equipment was researched, specified and quoted. The equipment is capable of washing all of the tank sizes currently used as well as drums and totes. DBE is expected to clean most of the products as the tank washing equipment sprays the surfaces with higher pressure and increased flow. Water-based products are not compatible with DBE and will not be cleaned with this equipment. The machine would free up labor as well as increase the number of tanks that can be washed per day. Washing drums would allow the facility to reuse some drums as opposed to having to buy new drums and send old ones for reconditioning.

Bucket Management

The startup and shut down standard operating procedures for the product filling lines were updated. Most products are packaged with two separate component bags that are mixed by the customer when ready to use. Each component bag contains a specific amount of material that requires adjustments and fine tuning of the filling equipment when product changes are made. New standards and dedicated containers were tested and put in place over the summer which allow reuse of all material used during filling equipment set-up and shut down. These procedures are saving a projected 100 pounds of material a week and eliminating the need for disposal of valuable product.

Recommendation	Annual Reduction	Annual Savings	Status
Replace MEK with TOU and DBE in production	98,000 lbs of hazardous waste	$46,000	Implemented
Replace MEK with DMC and TOU in lab	100 lbs of hazardous waste	$130	Recommended
Use sprayer for solvent application	13,000 lbs of solvent	$20,000	Implemented
Automated tank washer	98,000 lbs of hazardous waste	$36,000	Planned
Bucket Management	5,000 lbs of product	$19,000	Implemented

MnTAP Advisor: Paul Pagel, Senior Engineer

Sappi

Breanna Sobania
Chemical Engineering
University of Minnesota Duluth

Company Background

Sappi is an international pulp and paper company, with the Cloquet mill opening in 1898. They produce kraft pulp for their graphic paper products and dissolving pulp which they sell as a raw material for the textile industry.

"My internship with MnTAP allowed me to use skills that I learned in the classroom and apply them to real life engineering solutions. Sappi has such an amazing team and they were wonderful to work with. Working at Sappi gave me experience working with several different teams, allowing me to experience different aspects of engineering" ~ BS

Project Background

This project included two distinct processes, compressed air and solid waste. Sappi currently produces approximately 9,000 CFM of compressed air to run equipment, actuate valves and control processes. A system of this size requires regular assessments for leaks and Sappi conducts these yearly. One goal of this project was to standardize the assessment procedure to ensure the entire compressed air system is adequately addressed.

Sappi segregates many waste streams including industrial waste, recyclables, pallets, and combustible derived fuel (CDF), which is material that is used in on-site boilers to produce steam and electricity for the mill. Sappi had identified opportunities for better waste segregation in their pallet, industrial, and CDF waste streams with the goal of reducing each stream and increasing efficiency of segregation between the streams.

Incentives To Change

Sappi has seen a reduction in the savings reported by their annual compressed air leak assessment due to turnover in the contractor conducting the assessment and the lack of a standardized monitoring procedure. With an extensive compressed air system, opportunity for energy savings is apparent, but in-depth procedures are needed to realize this opportunity yearly. Sappi also has many waste streams some of which go off site for disposal and some that stay on site for reuse or landfilling. An opportunity exists to divert some of the waste that leaves the site to be internally reused or eliminated entirely which would save in off-site disposal costs.

"This past summer was the first experience for Sappi to partner with MnTAP's intern program. Sappi has employed students for a 15-month co-op for many years, but have a long-held belief that the mill is too large and complicated to get significant return from a summer intern. The performance of our intern was beyond expectations and has changed our belief regarding summer interns. The work of our intern will help Sappi reduce energy use and cost – immediately through better air leak identification and long term through operational and capital improvements. Additionally, through a second project that our intern completed, we are already making progress in improving our waste disposal systems. We are already thinking about a project for our next MnTAP intern."

~ Robert Schilling
Environmental Manager

Solutions

Follow Compressed Air SOP

Map areas and write SOP's for the walking routes the auditors should take to ensure they walk past all the instrument stands, receivers, filters, and areas that are densely filled with air lines. The audit should take place when the equipment is running and on down days when interferences such as steam and vacuum are turned off. By doing this Sappi can reduce their energy consumption by 8,000,000 kWh and save $280,000 annually.

Install Master Air Controller

By implementing a master controller, Sappi's air compressors will be able to "communicate" with each other, allowing more efficient operation. This will reduce Sappi's energy consumption by 288,000 kWh and save them $19,000 annually.

Update Compressors #2 and #3 Controls

Updating the controls and valves on the compressors can increase the efficiency of the compressors and allow them to operate at lower throttles. The efficiency will increase by roughly 20% which equates to a reduction of 1,000,000 kWh and a savings of $35,000 annually.

Implement Yearly Waste Education

Sappi has weekly safety talks which are exercises the entire mill discusses and focus on creating a safer working environment. A waste reduction safety talk was given this summer with impressive results. By continuing education and adding additional signage and lids to certain dumpsters Sappi can reduce waste by 30 tons and save $5,900 annually.

Reuse Pallets with Community Pick Up

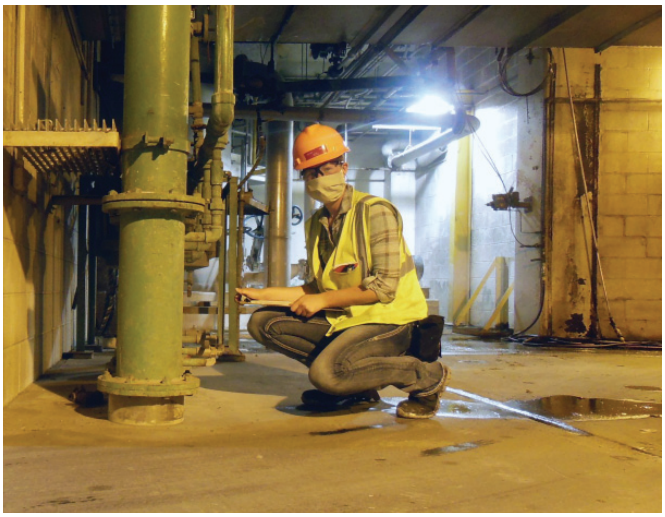
By moving the pallet pile to a more accessible area, Sappi can implement a spot for people to take pallets. This will divert 20 tons of pallets from the landfill and save $1,500 annually.

Reuse Pallets with Supplier Pick Up

Sappi's pallet supplier occasionally sends off-specification pallets that are not usable in Sappi's packaging process. If the supplier were to take these pallets back it would divert 20 tons of pallets from the landfill annually and save Sappi $1,500.

Reduce Waste by Core Recycling

Sappi uses paper cores to make rolls of paper. The supplier offers an option to recycle the broken cores and trimmings for the cost of shipping. This would reduce 66 tons of waste and save Sappi $20,000 annually.



Recommendation	Annual Reduction	Annual Savings	Status
Follow Compressed Air SOP	8,000,000 kWh	$280,000	Planned
Install Master Air Controller	402,000 kWh	$19,000	Recommended
Update Compressors #2 and #3 Controls	1,000,000 kWh	$35,000	Recommended
Implement Yearly Waste Education	30 Tons	$5,900	Implemented
Reuse Pallets with Supplier Pick Up	20 Tons	$1,500	Recommended
Recycle Cores	66 Tons	$20,000	Recommended

MnTAP Advisor: Brent Vizanko, Associate Engineer

St Croix Forge

Leah Ness
Mechanical Engineering
University of Minnesota Twin Cities

Company Background

St. Croix Forge's production facility and warehouse are located in Forest Lake, MN. Owned by Mustad, an international hoofcare product company, St. Croix Forge is the leading manufacturer of steel horseshoes in North America, and they are Mustad's only location in the United States. They produce over 500 different varieties of steel horseshoes. They employ about 50 people at the plant.

"Through this internship I was able to receive valuable industry experience while impacting the environment in a positive way. Working for St. Croix Forge provided me with the opportunity to gain skills involving writing and performing my own test procedures as well as improving upon my communication skills. I also became familiar with a large manufacturing environment and working with people of varying disciplines." ~ LN

Project Background

One of Mustad's current goals is to reduce their carbon footprint as a company. This project focuses on two methods of reducing the carbon footprint of the production facility of St. Croix Forge: reducing electrical energy consumption and waste generation in the form of scrapped steel. In the past, St. Croix Forge has completed several projects in order to reduce waste and energy consumption including another internship with MnTAP, but there are still opportunities to reduce further. Currently about 31% of all processed steel becomes scrap and 93% of the energy consumption is electrical energy. Upgrading equipment and reducing scrap by implementing new standard operating procedures will reduce energy consumption and waste generation at the facility.

Incentives To Change

The primary motivation in pursuing the intern project was to reduce material consumption and energy usage. It is a companywide goal to reduce their carbon footprint as much as possible, which can be done through both of these methods. St. Croix Forge and Mustad as a whole are always looking for ways to improve the efficiency of their processes through standardization and reducing waste in the form of energy and scrap.

"We would like to thank Leah for her outstanding summer internship. She was great and disciplined to achieved the expected goals of our company. The results are showing and we are beyond happy about it. This is our second partnership with MnTAP and we are looking for future projects that we can both work on together."

~ Dooglas Escobar Moran
Production Support Supervisor

Solutions

Optimize Lighting

Currently, the majority of the lighting at St. Croix Forge is fluorescent lighting. Upgrading lighting in the production building by replacing all current fixtures with LED fixtures will reduce energy consumption and energy costs. Along with saving energy and associated costs, these new fixtures have a longer life, higher efficiency, and will provide a safer working environment than the current fixtures. This recommendation is estimated to save 79,000 kWh and $11,000 in annual energy and bulb costs.

Install Flow Meter for Die Lubricant

Die lubricant is used as a release agent between the dies and the forged shoes. Installing flow meters on die lubricant lines will give St. Croix Forge better control over usage and allow for optimization. The savings associated with installing flow meters on all lines is 320 lbs of die lubricant and $420 annually, but there is also predicted to be a savings due to increased die life and reduced scrap from standardizing the die lubricant usage.

Defect Correction

A defect is when an issue occurs during the manufacturing process that causes a shoe to be incomplete or of bad quality. Implementing standard operating procedures for when a certain number of defects of a specific type have been produced will allow issues to be addressed immediately and reduce scrap. The potential savings for this recommendation is 60,000 lbs of steel and 19,000 kWh for a total cost savings of $17,000.

Standardize Crop Length

There is a portion of the horseshoe, called the crop, that is held during the forging process that is trimmed off once the horseshoe is fully formed. The current standard crop length is 5/8 inches. By establishing a standard operating procedure for checking crop length during production and altering the necessary fixtures, 25,000 lbs of raw steel and 5,200 kWh in energy from heating could be saved, with an annual cost savings of $8,700.

Reduce Idling Time of Forge Press Motors

Currently, the forge press motors spend an average of 12.5% of the time idling when they aren't producing horseshoes. The time forge press motors spend idling can be reduced to 5% by putting a standard operating procedure in place for when the forge press motors should be turned off when the production line is shut down. This reduction option is estimated to save 44,000 kWh of electrical energy and $4,400 in energy costs.

Implement New Die Steel

The molds used to form the steel into horseshoes are called dies. Replacing the current tool steel H13 that is used to make the dies with LSS 2367, which has a potentially longer life, could provide a savings of 11,000 lbs of tool steel per year. This is assuming the same amount will be spent on tool steel annually, but there is potential for further reduction. Also, there is predicted to be a savings regarding reduction in scrap, improved quality, reduction in heat treatments, and reduction in downtime to replace dies.

Recommendation	Annual Reduction	Annual Savings	Status
Optimize Lighting	79,000 kWh	$11,000	Implementing
Die Lubricant SOP	320 lbs	$420	Implementing
Standardize Crop Length	25,000 lbs	$8,200	Implementing
	5,200 kWh	$520	
Defect Correction	63,000 lbs	$16,000	Implementing
	26,000 kWh	$2,600	
Reduce Idling Time of Forge Press Motors	44,000 kWh	$4,400	Recommended
Implement New Die Steel	11,000 lbs	N/A	Waiting on test results

MnTAP Advisor: Michelle Gage, Engineer

U of M Physicians

Olajumobi Akeeb
Chemical Engineering
University of Minnesota Duluth

Company Background

University of Minnesota Physicians (M Physicians) is a multi-specialty group practice for the U of M Medical School faculty. M Physicians partnered with Fairview Health Services, creating a shared care delivery system - M Health Fairview. The M Health Fairview Clinics and Surgery Center (CSC) in Minneapolis, Minnesota employs 2,700 people and provides a variety of healthcare services including clinical exams and surgeries.

"This internship gave me the opportunity to have a meaningful summer and make an impact. I got the chance to manage a meaningful project, make recommendations that would be implemented and contribute to the overall sustainability goal of M Physicians. I am incredibly grateful for the support of my company supervisor and my MnTAP advisors, thank you for making this a great experience!" ~ OA

Project Background

Consultants were hired to conduct energy reduction and comfort improvement studies at another M Physicians owned building. The studies involved understanding the existing conditions of the building and making recommendations for improvements. The parameters examined included electricity cost, energy use index (EUI), air quality and comfort, lighting, plug loads, and HVAC.

M Physicians has made great strides in improving the environmental performance of their buildings while maintaining a high quality of care for their patients. The next step in their facility wide evaluation is to study the performance of the CSC and identify opportunities for improvements.

Incentives To Change

M Physicians aims to reduce energy consumption in their use of steam, chilled water, and electricity, and optimize the control of energy consuming equipment like steam boilers, monitors, and desktops. Reducing energy consumption not only reduces operating costs, but also improves the environmental performance of the building. The CSC used 1,500 therms of natural gas and 6 million kilowatt hours (kWh) of electricity in 2019, and this provides a major opportunity for savings and optimization. This will also lead to a reduction in the natural gas used by the University of Minnesota, a vendor of the CSC. It is estimated that if the CSC implemented the top two recommendations, they would save 460,000 kWh/yr which would lead to a natural gas savings of over 49,000 therms/yr by the University of Minnesota's Main Energy Plant.

SOLUTIONS

Computer Management

The computers in the CSC currently run for 24 hours per day because of the required daily updates carried out by the Office of Information Technology (IT). By changing the settings of the computers to be fully operational for no more than 12 hours per day and on standby or sleep mode for the remaining 12 hours, the PCs will still have the ability to be updated while consuming significantly less power. Based on the specifications of the computers in the CSC, if the recommended schedule change is applied throughout the building, an estimated 280,000 kWh/yr could be saved, translating to a monetary value of $31,000/yr.

Light Scheduling

Light fixtures in areas of the CSC without control are currently operational 24 hours per day. Implementing a schedule to control when the lights are operational and for how long, not only reduces this by 180,000 kWh/yr, but it also creates an opportunity to save over $19,000/yr.

Solutions

Advanced Power Strips (APS)

The implementation of APS in the CSC is limited because of hospital regulations and safety concerns, however, they provide a low-cost strategy to save energy from peripheral office loads like computer monitors, task lighting, and other electronics. Based on an estimate of 540 computers in the applicable areas, with one APS for two computers, this recommendation will save 69,000 kWh and $7,600, annually.

Light Switch Reminders

The use of labels to remind occupants to turn off the lights when they leave a room can conserve energy, and this can be implemented by the CSC in the form of light switch reminder stickers. The 5th floor of the CSC presented an opportunity for the implementation of this idea because of the traditional light switches installed there. This recommendation allows for additional savings opportunities as it motivates staff and patients to turn off the lights when they leave the area. It is estimated that up to $2,000 /yr and 18,000 kWh/yr could be saved.

Green Team

A green team serves as a task force comprised of hospital staff members who are passionate about the environment. They would be the ambassadors for sustainability, and volunteers responsible for establishing goals, monitoring progress, and overseeing the implementation of new ideas. The formation of this group could help ease the transition of the staff into a new method of operation, which would lead to a reduction of energy use and waste.

"The intern's initial analysis of our data changed our assumptions about where to focus in subsequent energy savings investigations. Her analysis revealed HVAC equipment that was improperly commissioned when the building was built five years ago. We are extremely pleased with MnTAP and expect to realize continued savings from the recommended projects as well as new energy savings projects which will grow out of this successful internship partnership."

~ Stephen Bassett LEED AP, Director Facilities Maintenance

Recommendation	Annual Reduction	Annual Savings	Status
Computer Management	280,000 kWh	$31,000	Planned
Light Scheduling	180,000 kWh	$19,000	Planned
Advanced Power Strips	69,000 kWh	$7,600	Implementing
Light Switch Reminders	18,000 kWh	$2,000	Planned
Green Team	N/A	N/A	Recommended

MnTAP Advisor: Brent Vizanko, Associate Engineer; Taylor Borgfeldt, Pollution Prevention Specialist

MN Drinking Water Utilities

Tiffany Schindler
Physics
University of Minnesota Twin Cities

Project Background

MnTAP hired a student researcher in September 2019 to assist in a market study on energy efficiency at drinking water utilities in the state of Minnesota. Drinking water utilities in Minnesota are estimated to use 379 million kilowatt hours (kWh) per year. Funded by a CARD Grant from the Minnesota Department of Commerce, this ongoing project aims to find best practices for energy management in water treatment plants (WTP) and relay this information to electric utilities that can create rebate programs to incentivize changes.

"This internship gave me the opportunity to use what I had been taught in a classroom in a real setting. I was able to gain experience and confidence in analysis, communication, and time management while working to make an impact in one of the most universal industries. I don't think I'll ever see water the same again." ~ TS

Why Drinking Water Utilities?

Drinking water utilities are one of the most widespread industries across the nation, yet most research is focused on utilities that serve over 100,000 people. In Minnesota, this only includes four cities out of the 655 cities that have municipal water permits. Smaller utilities have fewer resources to investigate efficiency opportunities and lack the time and capital to optimize their current system. Best-practices and rebate programs can allow utilities to increase their efficiency despite a lack of resources.

Project Goal

The main goal is to help electric utilities create rebate programs in order to incentivize energy efficiency upgrades in drinking water utilities. Specific goals include:

- Gaining an understanding of drinking water utility operations by interviewing a state-wide representative sample.
- Analyzing energy costs of WTPs to find where energy is used and identify efficiency opportunities.
- Conducting assessments for specific opportunities.
- Estimating energy savings for identified opportunities.
- Reporting best-practices to energy utilities.

Key Research Findings

Energy footprints were calculated for each site that provided energy data. These footprints were calculated for each plant overall and for acquisition, treatment, and distribution. These footprints indicate that treatment is typically the least energy intensive operation and that acquisition and distribution use a similar amount of energy. These findings will help identify potential energy efficiency upgrades for this industry and help electric utilities develop rebates for common upgrades.

Size	Acquisition (MG/kWh)	Treatment (MG/kWh)	Distribution (MG/kWh)
Small	1,100	400	1,000
Medium	700	300	600
Large	900	450	900
Overall	900	350	900

MnTAP Advisor: Brent Vizanko, Associate Engineer

Apply to Become a MnTAP Intern

Students See Success

MnTAP is seeking junior and senior-level college students to work on water conservation, energy efficiency, lean manufacturing, source reduction, and pollution prevention projects at companies in Minnesota. The projects are located at companies in a variety of industries around the state.

As with many internships, the MnTAP intern program provides students with an experience that helps prepare them for their future careers. Past interns have attributed their experience in the MnTAP program to their career successes.

MnTAP internships not only provide hands-on experience in a variety of facilities, but also provide students with the opportunity to manage a project, develop and test ideas, and often see their solutions implemented. When asked about their experiences, past interns credit the MnTAP intern program with providing a variety of opportunities.

Interns have represented 29 different majors and more than 28 colleges and universities. In total, 300 students have gained experience through a MnTAP internship over the past 36 years.

Student Benefits

- Positively impact a facility's environmental footprint
- Gain hands-on project management experience
- Use your classroom knowledge in a real-world setting
- Earn $17.00/hr and work 40/hrs a week

Applications are being accepted for summer 2021 internships. Interviews will be held January, 2021 through March, 2021. Selected applicants will be matched to a project based on academic background and performance, relevant experience, and technical skills.

To apply, complete the online application form.
www.mntap.umn.edu/interns/student

2020 Interns

Top Row L-R: Breanna Sobania, Aiden Kamber, Anja Savic, Bethany Mestelle, Yaakov Knobloch, Natalia Kaliszewski, Lydia DeBuhr
Middle Row L-R: Olajumobi Akeeb, Tiffany Schindler, Nahir Hurtado, Mika Rodrigues, Madison Best, Mason Balster, Matthew Landauer
Bottom Row L-R: Jerald Lim, Ingrid Chan, Gabriel Pfeiffer, Elisabeth King, Elizabeth Jambor, Ella Carlson, Leah Ness

MnTAP SOLUTIONS

Minnesota Technical Assistance Program
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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 in addition to the intern program include site visits, team facilitation and phone assistance.

MnTAP is funded by a 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.

Laura Babcock
MnTAP Director

Taylor Borgfeldt
Pollution Prevention Specialist

Daniel Chang
Associate Engineer

Matt Domski
Waste Prevention Specialist/ Intern Program Coordinator

Michelle Gage
Engineer

Josh Kirk
Associate Engineer

Nathan Landwehr
Waste Reduction Specialist

Paul Pagel
Senior Engineer/ Intern Program Coordinator

Jane Paulson
Senior Engineer

Alaina Ryberg
Website Designer

Frank Strahan
IT Supervisor

Jon Vanyo
Engineer

Brent Vizanko
Associate Engineer

Carol Wiebe
Communication Specialist

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