MnTAP

SOLUTIONS

MnTAP Intern Program 2017

MnTAP Intern Program

A History of Success

For over 30 years, MnTAP has been coordinating an intern program that places highly qualified students in facilities for up to three months to 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 impact of intern projects has reached far beyond the host facilities; many solutions identified can be applied to other companies. From Thief River Falls and International Falls, to Albert Lea, Preston, and Jackson, MnTAP intern projects stretch across all of Minnesota.

Companies Reap Rewards

More than 275 companies have been served by the MnTAP Intern Program over the past 32 years. Interns have worked with companies small and large, and in industries such as hospitality, healthcare, manufacturing, and food processing. Since 1985, intern recommended solutions have saved Minnesota companies 457 million gallons of water, 40 million kWh, 3.3 million therms, 110 million pounds of waste, and 12 million dollars annually!

Students See Success

The Intern Program is popular with students as well. Interns have represented 27 different majors and more than 24 colleges and universities. In total, 250 students have gained experience through a MnTAP internship over the past 32 years.

The bottom line is MnTAP intern projects result in solutions that positively impact a business and reduce its environmental footprint.

Join the Intern Program in 2018

For Companies

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

With the help of a MnTAP intern, your business will receive suggestions to improve efficiency, save money, reduce waste and material usage, or decrease your regulatory compliance burden. As with all of MnTAP's projects, proprietary information at your facility is kept confidential during and after the intern project.

Company Benefits:

- A fresh set of eyes with dedicated time
- Project guidance by a MnTAP staff
- A full report detailing the intern's work and next steps
- MnTAP managing the recruiting and training process

Now is the time to start thinking about developing a project for the summer of 2018. Applications are accepted until **February 1, 2018**. Companies will be contacted for additional project development and scoping. We request companies to contribute $3,000 to help support the intern program. These funds are used to offset project cost. Complete an online project proposal or call MnTAP today!

For Students

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 at locations around the state.

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 $15.00/hr and work 40/hrs a week

Applications are being accepted for summer 2018 internships. Interviews will be held January, 2018 through March 1, 2018. Selected applicants will be matched to a project based on academic background and performance, relative experience, and technical skills. To apply, complete the online application form and submit it with your cover letter, resume, and unofficial transcript.

For more information and applications, contact Paul Pagel, Intern Coordinator, at 612-624-4638, ppagel@umn.edu, or at mntap.umn.edu/interns/student

2017 Intern-Proposed Solutions

Recommendation	Reduction	Cost Savings	Equivalents (annual)
Water	271,848,000 gallons	$141,100	Water for 11,458 Minnesota residents
Waste	1,079,000 lbs	$103,200	Weight of approx. 11 Metro Transit light rail cars
Chemicals	230,500 lbs	$36,700	Approximately 460 55 gallon drums
Electricity	9,589,000 kWh	$1,078,100	Electricity for 1,000 Minnesota homes
Gas	88,000 therms	$50,500	CO_2 emissions from 92 passenger vehicles
Production Impacts	---	$181,100	---
Total Potential Cost Savings	---	**$1,590,700**	---

Focus	Organization	Intern	MnTAP Advisor	
Energy	Advanced Extrusion	Tiger Rost	Paul Pagel, Sr. Engineer	6
Water	Aqseptence	Ryan Pauly	Jane Paulson, Sr. Engineer	8
Water	Bailey Nurseries	Christine Pelto	Michael Jost, Sr. Engineer	10
Energy	Center for Energy & Environment	Leah Kunkel	Jon Vanyo, Assoc. Engineer	12
Water, Lean	CertainTeed	Alex Witte	Karl DeWahl, Sr. Engineer	14
Chemicals	City of Minneapolis	Gina Sternberg	Karl DeWahl, Sr. Engineer	16
Energy	City of New Prague	Emily Wen	AJ Van den Berghe, Engineer	18
Water, Energy	DiaSorin	Yohanes Agustinus	Michael Jost, Sr. Engineer	20
Water, Chemicals	Electric Machinery Company	Brady Halvorson	Jon Vanyo, Assoc. Engineer	22
Water, Energy, Chemicals	Fulton Brewing	Karl Wuolo-Journey	Michelle Gage, Assoc. Engineer	24
Water, Energy Chemicals	Kerry Ingredients	Denzel Bibbs	Matt Domski, Organic Waste Specialist	26
Energy, Water	Phillips Distilling	Nathaniel Scherer	Michelle Gage, Assoc. Engineer	28
Chemicals	Phillips Neighborhood Businesses	Madeline Norgaard	Nathan Landwehr, Waste Reduction Specialist	30
Energy, Lean, Waste	Plastech Corporation	Emily Daniel	Michelle Gage, Assoc. Engineer	32
Waste, Chemicals, Lean	Seneca Foods	Daniel Chang	Matt Domski, Organic Waste Specialist	34
Energy	SkyWater Technology Foundry	Brandon Noel	AJ Van den Berghe, Engineer	36
Chemicals, Waste, Energy	Smith Foundry	Al Muntasar Al Busaidy	Jane Paulson, Sr. Engineer	38

Project Focus Key

 Chemicals

 Electricity/ Natural Gas

 Lean

 Water

 Waste

MnTAP thanks our generous partners who make this vital work possible. Each of these organizations contributed financially to the intern program for 2017. Their support helps maintain our continuing pollution prevention, energy efficiency and water conservation work.

MINNESOTA POLLUTION CONTROL AGENCY

"One of the best parts of this program is not just the benefits realized by this year's participating companies but also how these interns gain skills that they will take with them to the companies they will work for throughout their careers."

~ Mark Snyder, Pollution Prevention Coordinator, MPCA

cee Center for Energy and Environment

METROPOLITAN COUNCIL

"MnTAP continues to be a critical resource in increasing industrial and commercial water efficiency in the Twin Cities metropolitan area. The Metropolitan Council is proud to be a partner in this effort."

~ Brian Davis, Senior Engineer, Metropolitan Council Environmental Services

SOUTHERN MINNESOTA MUNICIPAL POWER AGENCY
Bringing power to your life.

"This is the second year in a row that we have sponsored an MnTAP intern. With our limited staff resources, this has been a wonderful opportunity for us to have someone identify and quantify energy efficiency measures that we wouldn't be able to address otherwise."

~ John O'Neil, Manager of Energy Efficiency & Member Support Programs, South Minnesota Municipal Power Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

"The interns assistance to businesses has been a valuable resource in supporting EPA's mission to protect human health and the environment, while also supporting businesses' bottom line. The project management and technical skills acquired will provide a strong foundation for continued efforts in pollution prevention and sustainability."

~ Christine Anderson, Pollution Prevention Coordinator, U.S. EPA, Region 5

FranklinEnergy™

COMMERCE DEPARTMENT ENERGY RESOURCES

"The technical assistance provided through MnTAP's internship program has been a valuable asset in supporting the Minnesota Department of Commerce's mission to identify and implement cost-effective energy savings opportunities throughout the state."

~ Adam Zoet, Energy Planner Principal, MN Deptartment of Commerce, Division of Energy Resources

Xcel Energy® RESPONSIBLE BY NATURE®

"Xcel Energy continues to value the MnTAP Intern Program and the projects that are identified each year. Providing an engineering intern through the MnTAP Program is a valued extension of Xcel Energy's overall Energy Efficiency offerings."

~ Lori Nielsen, Product Portfolio Manager, Xcel Energy

CONNEXUS® ENERGY

Washington County

"Washington County has been thrilled to partner with MNTAP to provide assistance to facilities in our county through their staff outreach, site assessments, and funding an intern. The program has raised awareness of water conservation and efficiency opportunities, while also helping participating facilities to institute some real water saving."

~ Fran Miron, Washington County Commissioner, Washington County Public Health & Environment

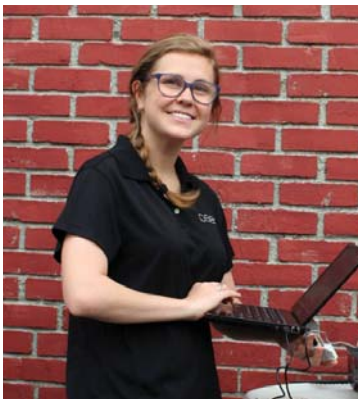
ECE East Central Energy
Your Touchstone Energy® Cooperative

"The MnTAP intern program supports ECE's cooperative mission statement by providing a valuable service to our member owners with a high-level professionalism and support."

~ John K. Bosman, Business Accounts Specialist, East Central Energy

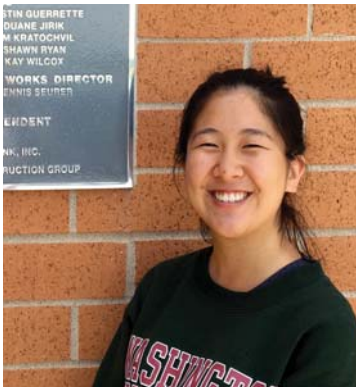
MINNESOTA ENERGY RESOURCES








"MnTAP has been honered to work with this outstanding group of interns in 2017. They have gained great expereiences while providing valuable SOLUTIONS for their host companies."
~ Laura Babcock, MnTAP Director


MnTAP

Advanced Extrusion

Tiger Rost
Aerospace Engineering,
University of Minnesota Twin Cities

Company Background

Advanced Extrusion is a business to business supplier of rolls of polyester for the thermoforming and laminating industries. Material such as polyethylene terephthalate (PET) is extruded into sheets that are used to produce food packaging. The company out grew a plant in Becker, MN and moved to a 190,000 square foot facility in Rogers, MN. Sixty-eight employees manufacture over 30 million pounds of polyester sheet annually.

"Addressing energy usage helps not only our clients save money, but helps keep the energy use in our state sustainable. Looking through the opportunities, I believe not only the intern, but people at the company walk away with a new perspective on how important it is to save energy. What is really exciting is that often people will start coming up with their own ideas and suggesting improvements long outside the scope of the internship, and that's the kind of thinking needed to be good stewards of our environment." ~ TR

Project Background

Plastic extrusion is an energy intensive process. Advanced Extrusion receives pelletized material which often requires crystallization and drying for several hours at temperatures from 200° F to 350° F. A vacuum system conveys material to blenders before being sent to one of seven extruders. Extruders use heat and pressure to force the material through a screw, a die and on to rollers to form a sheet. This sheet is then quickly cooled and wound up into rolls. Electricity and natural gas are used through these steps. Opportunities to use energy more efficiently were a focus of this project.

Incentives to Change

The plant spent over $1,000,000 on electricity in 2016. The company anticipates increasing production needs and is looking to continually improve the manufacturing processes. Increased efficiencies can allow them to remain competitive in the market and increased throughput will allow them to meet the future demands of their customers.

"Advanced Extrusion has many motivations to change our current energy demands. The first is to reduce our energy footprint and become more responsible consumers. As the company has grown, our electricity usage has increased two-fold. We also want to reduce our monthly energy bills and use the savings for process improvements, and capital expenses, in order to maximize profit."
~ Brandon Eid, Process Engineer, Advanced Extrusion

Solutions

Update Lighting

The existing 32W fluorescent lamps are planned to be converted to 15W LEDs. Motion sensors could be added to further reduce lighting hours and lower the baseload energy use. Battery packs are being added to selected fixtures to act as emergency lighting during power outages. These opportunities are being implemented which will reduce 362,7,00 kWh of electricity, saving $29,000 with a 1.8 year payback.

Fixing Heat Losses and Leaks

Compressed air leaks, material conveying systems gaps and drying/crystallization equipment heat losses lead to increase electric load. Addressing these specific issues in the systems will save 1,153,000 kWh of electricity, saving $92,400 with a payback under 5 months.

Switch to Efficient Motors and Drives

A detailed motor inventory was documented for the plant. A plan was developed to replace some motors with more efficient motors, convert extruder motors from DC to AC, and add variable frequency drives to certain motors. Adding controls and sensors to the grinding operation could reduce the electric use in that department. Motor system improvements would improve the power factor for the facility, save 2,086,000 kWh of electricity, save $178,000 and have a 6 month payback.

Change Production Settings

Making adjustments to its dryer cycle times and crystallization temperature settings to reduce the energy use per pound of material was suggested. There is some concern that product throughput may be reduced. Lengthening the regeneration cycle of the dryer beds and lowering the crystallization temperatures could save 487,000 kWh and $39,000. Gradually changing the settings over time will allow for monitoring of product quality and throughput.

Miscellaneous Upgrades

- Improvements to the dust collection system would result in increased safety, improved housekeeping, and a lower defect risk. By improving dust control, worker conditions improve and the frequency of extruder screen changes will likely be reduced.
- Electric curtailment does not change energy consumption, but results in an estimated $62,600 annual cost savings by agreeing with the utility to reduce electric use during peak demand periods.
- Alternative fuel modifications could reduce electric usage and costs while facilitating curtailment options.

Equipment Upgrades Needing Further Evaluation

Two large capital suggestions were also studied. Purchase of high vacuum twin screw extrusion equipment would eliminate the need for drying and crystallization. This equipment would improve throughput and reduce the relative production energy use. Adding PET compounding at the facility instead of buying processed materials could improve the overall process efficiency and save money despite using more energy. Compounding in-house could save $9,000,000 and extrusion equipment purchases could save 5,000,000 kWh of electricity and $400,000 annually.

Recommendation	Annual Reduction	Annual Savings	Status
Lighting	362,700 kWh	$29,000	In progress
Heat losses and leaks	1,153,000 kWh	$92,400	In progress
Efficient motors and drives	2,086,000 kWh	$178,000	In progress
Changing production settings	487,000 kWh	$39,000	Recommended
Miscellaneous upgrades	0 kWh	$256,000	Recommended

MnTAP Advisor: Paul Pagel, Senior Engineer

Aqseptence Group

Ryan Pauly,
Chemical Engineering,
University of Minnesota, Twin Cities

Company Background

Johnson Screens, a brand of Aqseptence Group Inc., was founded in 1904 by Edward E. Johnson after developing the world's first continuous slot wire wrapped screen to be used in a water well. Johnson Screens is the leading brand for screens in industrial filters, water well, and architecture. Products are used in a wide range of industries, including chemical and pharmaceutical and oil and gas. Johnson Screens is located in New Brighton, where it has resided since 1971.

"Working at MnTAP has allowed me to grow as an engineer and learn about the industrial workplace. I have been challenged to understand unfamiliar processes and find solutions to complex problems in a new environment. MnTAP has provided me the support to be successful and has given me an opportunity for a hands-on work experience that I would not have received in other internships." - RP

Project Background

Production of Johnson Screens' trademark cylindrical screen uses water to quench the welds on the screens. On an annual basis, approximately ten million gallons of water is consumed to carry out this quenching process, as well as other smaller processes performed on the production floor. The ten million gallons of water annually used costs Johnson Screens about $120,000. Johnson Screens wishes to reduce the amount of water that is used annually by 30% by improving the water recycling systems currently in place and reducing the amount of water used for quenching the welds.

Johnson Screens also wishes to be able to manufacture National Sanitation Foundation (NSF) certified products with recycled water. The chromium content in the recycled water is currently preventing this from happening. NSF certification, an independent third-party certification, would allow Johnson Screens to increase the markets where its products are distributed and increase profit.

Incentives To Change

Johnson Screens is conscientious of its footprint and wishes to reduce the impact that its production processes have on the environment. Reduction of water would increase profitability of the company and efficiency of the processes. NSF certification has been removed from an increasing number of products, when water started to be recycled. A recycling system that controlled containments would allow those products to be recertified by the NSF and sold at an increased price.

"Aqseptence Group, Inc. is a manufacturing facility that uses 10 million gallons of water a year. This summer Ryan has been able to identify, recommend and build a prototype water recycling system. With this system we should be able to achieve NSF approval for our products using recycled water instead of using straight city water. With the multiple recommendations that Ryan has provided, we should be able to conservatively reduce our water use by close to 2 million gallons a year. Ryan has been a great self-starter who has been appreciated and respected by everyone with whom he has interacted. We have enjoyed working with Ryan and know that he will be very successful in his future endeavors."

~ Paul Johnson, Aqseptence

Solutions

Install Recycling Systems on Screen Machines

The water is currently contaminated with particulates, burnt oil, free oil, emulsified oil and lubricant. A water recycling system comprised of a centrifuge and ultrafiltration columns is recommended to be installed on all the screen machines. The water from all the screen machines is contaminated in the same manner, so the same recycling system will be able to effectively purify all the water. The recycling system will remove all contaminants from the water except for metal ions.

Install Ion Exchange Columns on Select Screen Machines

Welding of stainless steel screens causes an increased concentration of chromium in the quenching water that prevents NSF approved products from being made with recycled water. Removal of chromium can be carried out with ion exchange columns containing a strong acid cation resin. The ion exchange columns should be implemented on select screen machines and NSF approved products should be manufactured exclusively on these machines.

Apply Quenching Water Flow Control

Application of quenching water to the screens during the manufacturing process uses an excess amount of water. Water can be reduced by installing flow meters and replacing the ball valves with globe valves to increase flow control, while instructing operators to slowly open the glove valve until the weld is acceptable.

Install Closed Loop for Fine Wire Screen Machines

The electronics cooling water stream is separate from the quenching water stream on the fine wire screen machines, which is different from the other screen machines. The electronics cooling water is sent down the drain. Installation of a chiller and rerouting of the piping will allow reuse of the electronic cooling water without the need for any purification.

Eliminate Wire Mill Cleaning Water

The water used in the wire mill to clean the wire of lubricants is not contaminated when it is sent down the drain. The existing air wipes should be sufficient to dry and clean the wire of any contaminants that the water currently cleans. Further testing of this recommendation is required.

Recommendation	Annual Reduction	Annual Savings	Status
Install recycling systems: screen machines	940,000 gallons	$7,000	Implemented
Install recycling system: other machines	1,600,000 gallons	$12,000	Recommended
Install ion exchange	120,000 gallons	$870	Recommended
Apply quenching water flow control	82,000 gallons	$600	Recommended
Install closed loop cooling	780,000 gallons	$4,700	Recommended
Eliminate wire mill cleaning water	2,100,000 gallons	$15,400	Researching

MnTAP Advisor: Jane Paulson, Senior Engineer

Bailey Nurseries

Christine Pelto,
Geological Engineering,
University of Wisconsin-Madison

Organization Background

Bailey Nurseries is a locally owned and operated wholesale plant nursery. Currently in its 5th generation of family ownership, the company runs a multitude of farms near the Twin Cities, as well as farms in Oregon, Washington, Illinois, and Georgia. Bailey Nurseries is known for their diverse market, growing everything from woody ornamentals to perennial flowers.

"My time at Bailey Nurseries has taught me how to gather data in the field and apply it to real projects with definable outcomes. I've been able to interact and work with a variety of great people. Without them, I wouldn't have truly learned how to translate skills from the classroom to real life. I'll value my time at Bailey Nurseries for a long time." ~ CP

Project Background

The 2017 MnTAP intern project at Bailey Nurseries focused on water conservation and reuse opportunities and water use analysis at two farm properties in southern Washington County. The first project, Nord Farm, is a 22-acre indoor greenhouse and 40 acre outdoor seedbed operation located in Cottage Grove, MN. The second project is identified as Container East, a 250 acre container-grown operation in Woodbury MN.

The Nord Farm objectives were to document water flow patterns, determine water retention capacity in on-site ponds, and determine the optimal way to use pond water for daily irrigation, thereby reducing the volume of groundwater pumped. The water conservation objectives at Container East were to increase the irrigation efficiency and reduce the amount of sediment runoff leaving the farm.

Incentives To Change

Bailey Nurseries is located in the Minnesota Department of Natural Resources North and East Metro Ground Water Management Area, a designation allowing the DNR a more comprehensive and focused approach to water resource management. As a large water user, Bailey Nursery is interested in reducing groundwater use to protect the environment and preserve natural resources

"The MnTAP internship program provided a valuable and beneficial service to the nursery. Our intern went to work right away with enthusiasm and minimal supervision. Her work demonstrates a possible reduction in groundwater use by 75%, resulting in water quality improvements in runoff leaving the farm. Thanks to our intern's technical expertise and hard work, the nursery now has a path towards environmental sustainability for years to come."

~ Jean-Marc Versolato,
Production Manager Bailey Nurseries

Solutions

The Nord Farm: Pumping System

The Nord Farm project mapped the precipitation flow and drainage system on the property and proposes a pond pumping and treatment system that will reuse and recycle irrigation and rain water, therefore reducing the amount of water pumped daily from the groundwater table. Pumping from a surface water pond will reduce the amount of runoff and sediment that leaves the farm.

Based on research findings, there is the potential to save 38 million gallons of water per year at Nord Farm.

Container East: Irrigation Improvements

The Container East project determined whether or not the plants can be irrigated less frequently or for a smaller amount of time. Test criteria included substrate water holding capacity, plant available water, substrate nutrition, irrigation uniformity, irrigation capture, and leaching fraction. In order to adjust the irrigation schedule additional extensive research would have to be done to see which plants can handle less irrigation. However, if the substrate is changed to increase its water holding capacity, the plants could be watered less, saving water used per year at Container East by 10 million gallons.

Recommendation	Annual Reduction	Annual Savings	Status
Nord Farm: Pumping system	38 million gallons	Dependent on funding	Recommended
Container East: Irrigation improvements	10 million gallons	Further investigation needed	Recommended

MnTAP Advisor: Michael Jost, Senior Engineer

Center for Energy & Environment

Leah Kunkel,
Mechanical Engineering,
St. Louis University

Organization Background

Center for Energy and Environment is a Minnesota-based nonprofit that promotes energy efficiency to strengthen the economy while improving the environment. For nearly 40 years, CEE has provided a range of practical and cost-effective programs to help homeowners, businesses, and communities reduce energy waste and save money. Offerings include low-interest financing, technical research, energy planning assistance, clean energy advocacy, and innovative programs. The Energy Intelligence program works with small industrial businesses to help them better understand how they're using energy, and how they could improve their practices. The program is funded by Xcel Energy as part of Xcel's Conservation Improvement Plan portfolio.

"This internship has given me hands-on experience in a wide variety of sites, working to find energy efficiency improvements. I've had to get creative in my solutions: finding patterns in energy usage data, learning a new manufacturing process quickly to find inefficiencies, and preparing site reports quickly and thoroughly. Through this internship, I was able to challenge myself and grow in a field that I'm truly interested in and plan to pursue in the future." ~ LK

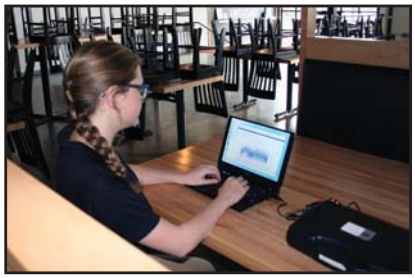
Project Background

CEE hosted a MnTAP intern in their Energy Intelligence program, and who focused on four different sites throughout the summer to investigate potential energy saving opportunities. These included St. Agnes Bakery, Endurance Technologies, Artistic Finishes, and Insight Brewing. Each of these businesses is currently growing, and is seeking to lower their energy usage, while simultaneously being able to produce more of their product.

Each site was set up with real-time monitoring before the project started, ensuring enough data was available before each two-week assessment period began. Each site had a list of project ideas that they were hoping to investigate further. The intern worked with every facility and their project ideas, gathered relevant information, and identified opportunities for savings.

Incentives To Change

The incentives for change vary by company, but each is looking to provide their product at the highest possible quality, while keeping energy costs low.



SOLUTIONS

The four businesses in this study benefited from specifically tailored solutions including:

- implementing automatic controls to turn off equipment when it is not in use
- reducing compressed air pressure set points and fixing leaks
- upgrading to LED lighting
- adjusting process temperatures
- investigating opportunities for VFDs
- identifying opportunities to upgrade to premium efficiency motors
- scoping the opportunity to implement solar arrays as a source of renewable energy

The total proposed savings from this project is 1.4 million kWh, for $123,000 in total potential savings.

Solutions

Saint Agnes Baking Company Recommendations

Recommendation	Annual Reduction	Annual Savings	Status
Reduce proofing box temperatures	4,898 kWh	$513	Recommended
Replace the seal on heated/cooled devices	460 kWh	$98	Recommended
Recycle waste heat from ovens	79,420 kWh	$9,094	Recommended
Replace motors with premium efficiency	3,790 kWh	$397	Recommended
Turn off office power strips	1,445 kWh	$150	Recommended
Total:	**90,013 kWh**	**$10,335**	

Endurance Technologies Recommendations

Recommendation	Annual Reduction	Annual Savings	Status
Replace motors with premium efficiency	1,540 kWh	$1,170	Recommended
Add an economizer to the boiler	N/A	$1,000	Recommended
Schedule ceiling fan operations	26,120 kWh	$3,853	Planned
Solar array	240,000 kWh	$30,000	Recommended
Computer power management	6,800 kWh	$420	Recommended
Lighting assessment	28,650 kWh	$3,477	Recommended
Total:	**305,710 kWh**	**$40,080**	

Artistic Finishes Recommendations

Recommendation	Annual Reduction	Annual Savings	Status
Install line controls and turn off lines	613,500 kWh	$38,100	Planned
Fix compressed air leaks	87,600 kWh	$9,280	Planned
Install gate controls for baghouse	34,000 kWh	$2,000	Planned
Reduce compressed air pressure	19,400 kWh	$1,200	Recommended
Adjust startup procedure	31,200 kWh	$1,900	Implemented
Lighting improvements	59,400 kWh	$5,950	Recommended
Total:	**867,300 kWh**	**$60,100**	

Insight Brewing Recommendations

Recommendation	Annual Reduction	Annual Savings	Status
Change lighting to LEDs	69,100 kWh	$7,400	Planned
Move chiller outside	35,000 kWh	$3,900	Implemented
Compressed air system adjustments	9,100 kWh	$730	Recommended
HVAC system upgrades/adjustments	5,900 kWh	$710	Recommended
Additional recommendations	6,400 kWh	$640	Recommended
Total:	**125,500 kWh**	**$13,380**	

"Building on the strengths of CEE's Energy Intelligence program, our intern added capacity and insights to help deliver even deeper energy assessments to the customers she visited. Although small businesses are often hindered by a lack of time or expertise to determine savings potential and specific steps for upgrades, our intern eliminated those barriers by thoughtfully investigating energy saving opportunities and laying out clear next steps for each customer."

~ Nicole Kessler, Program Manager, Energy Intelligence, Center for Energy and Environment

MnTAP Advisor: Jon Vanyo, Assoc. Engineer

CertainTeed

Alex Witte,
Mechanical Engineering,
University of Minnesota, Duluth

Organization Background

CertainTeed was founded as the General Roofing Manufacturing Company in 1904, and became CertainTeed in 1917. The company is now a subsidiary of Saint-Gobain, a French company that is one of the largest and oldest building products companies in the world. The CertainTeed division produces roofing products, insulation, siding, drywall and a range of other products at other plants in North America. The Shakopee facility produces asphalt roofing materials, using three production lines.

"MnTAP gave me a valuable learning experience that brought together many different aspects of engineering, research and communication. The struggles of balancing different peoples goals and understanding what opinions and knowledge added complexity and challenge. That ending up helping to achieve an end goal where everyone was satisfied, helping me gain necessary qualities that will add value to me. I have gained valuable connections and experience I can apply to any industry that I choose." ~ AW

Project Background

Shingle manufacture starts with a fiberglass web substrate, coats the substrate with hot, liquid asphalt, then applies colored mineral granules for appearance and wear, then the continuous sheet is cut and assembled into shingle products, and finally packaged.

CertainTeed is projected to use 31 million gallons of water in 2017 for a range of purposes. During shingle manufacture, cooling the sheet is an important function so that the cutting, assembly and packaging processes can function reliably at high speed and produce a consistent, high quality product. There are many different heat transfer mechanisms involved in cooling the sheet, but the two most important mechanisms involve water. Sprayed, single pass water cools the sheet by evaporation and accounts for 60% of the cooling. Recirculated water cools the steel rolls that guide the sheet through the process. This further cools the sheet by direct contact, and accounts for 30% of the heat removal. The sprayed water is of particular interest both because of the volume used and because any water remaining on the sheet during the shingle assembly step makes quality processing more difficult.

Incentives To Change

St. Gobain / CertainTeed have corporate sustainability goals to reduce water consumption by 20% by 2019 and ultimately to eliminate the discharge of industrial water entirely. Line 3, the focus of this project, consumes close to 9 million gallons of water per year, at a cost of $22,000. Additionally, cooling becomes more difficult in hot, humid summer weather when evaporative cooling is less effective and the chance of having a wet sheet at shingle processing increases. When evaporative cooling has been throttled back to keep the sheet dry, production needs to be slowed. The value of lost production capacity due to this issue is estimated to be $159,000 per year.

"CertainTeed strives to minimize the impact of manufacturing operations on the environment. Water usage reduction is a critical component of achieving that goal. Having a highly skilled MnTAP intern working on this project has allowed us to re-focus our environment efforts by understanding the true water reduction potential of our manufacturing operations. Without the MnTAP program, CertainTeed would not have been able to study water usage in as much detail and with as much technical thought and analysis."

~ DJ Damberger, Plant Manager, CertainTeed

Solutions

Install a Chiller for Recirculating Water to the Cold Rolls

The primary recommendation is to install a chiller to lower temperature of the water used in the cold rolls from 80° F to 60° F. This reduction in recirculated water temperature doubles the heat removal capacity of the cold rolls, making the system much less affected by atmospheric temperature and humidity, likely eliminating lost production due to weather. By cooling the sheet faster, the chiller system will lower the effectiveness of evaporative cooling in the cooler portions of the sheet. If water to the two, least effective, spray headers is shut off, 840,000 gallons per year of water will be saved. If overspray from the remaining headers can be eliminated through flow adjustments and improved procedures, a reduction of an additional 3 million gallons per year of water is possible. This change would have a one-time capitol cost of $315,000, with an increase of $24,000 in operation costs, but would have a 2.3 year payback based on $159,000 per year in recovered production capacity and $2,500 or more in water savings.

Install a Larger HoldingTank and Reducing Overflow

A second recommendation is for the semi-closed-loop, roll cooling water circuit. Installing a second 8,000 gallon tank, and a dedicated pump for the air compressors; softening makeup water; and improving the level and pumping controls should eliminate the 5 million gallons per year that currently overflow to the sewer drain – the single largest water conservation opportunity in the plant. This change would cost $100,000, but would have a 2.7 year payback based on $36,600 per year in water savings.

Recommendation	Annual Reduction	Annual Savings	Status
Chiller for recirculating water to the cold rolls	841,000 gallons 250 hours labor	$2,500 $12,500 Production gain: $159,000	Recommended
Larger holding tank and reducing overflow	7,400,000 gallons	$13,600	Recommended

MnTAP Advisor: Karl DeWahl, Senior Engineer

City of Minneapolis

Gina Sternberg,
Chemical Engineering,
University of Minnesota, Duluth

Organization Background

The City of Minneapolis Water Works was established in 1867, and began supplying drinking water to the City of Minneapolis in 1872. At present, they provide tap water to Minneapolis and several surrounding communities, producing and distributing an average of 57 million gallons of water per day.

"While my goals for the project were laid out for me, and I got as much help as I asked for, the ultimate choices for how to achieve the goal were up to me. I planned experiments, chose data to analyze, and decided what that analysis meant and how I should move forward. This freedom helped me to build problem solving skills that will be invaluable to me moving forward with my career." ~ GS

Project Approach

The Columbia Heights Membrane plant receives softened water from the main Fridley plant and provides additional final filtration and treatment capacity to the system. The Columbia Heights plant uses ultrafiltration membranes for the final filtration step while the Fridley plant uses media filtration to remove fine particulates. Water is then treated with chlorine, fluoride, sodium hydroxide, and an ortho-polyphosphate corrosion inhibitor, and then it is ready for distribution. The membranes at the Columbia Heights plant are cleaned and disinfected frequently and the chemicals and water used for this task need to be neutralized before being discharged back to surface waters. The goal of this project was to reduce the use of chemicals for waste neutralization.

Incentives To Change

The Columbia Heights Membrane Plant produces an average of 270,000 gallons per day of treated wastewater from membrane cleaning and disinfection operations. These processes consumes 170,000 lbs of sodium bisulfite (SBS) solution, 120,000 lbs of sodium hydroxide (NaOH) solution, and 80,000 lbs of bleach solution, costing $30,000 each year.

Neutralized waste is sent to a holding pond, and then into the Mississippi river. Salts form as a by-product of neutralization, so more efficient neutralization would lower salt concentrations and improve water quality of effluent into the river as well. The waste is currently within regulations, but Minneapolis Water is interested in preserving river health and improving waste water quality.

"For many years, we have suspected there were opportunities for more efficient use of chemicals in our neutralization process. We needed someone with strong capabilities in chemical process control to collect the data and evaluate the dynamic system. Having Gina work on site and with our plant operators and working at both the bench scale and with the full scale process provided the data and recommendations we needed."

~ Annika Bankston, Superintendent of Water Treatment Plant Operations & Maintenance, City of Minneapolis Water

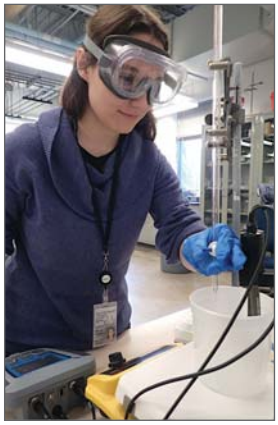
Solutions

Implement Self-Neutralization

The major recommendation of this project is the implementation of self-neutralization, which entails combining two different types of waste to partially treat each other before raw neutralization chemicals are added. Self-neutralization will save an estimated 34,000 lbs of SBS, 26,000 lbs of NaOH, and 80,000 lbs of bleach a year, resulting in a savings cost of $12,000. Programming for the automated self-neutralization is projected to cost $2,200. The time required for self-neutralization is essentially the same as for treating the two batches separately.

Recallibration of Pumps

A second recommendation is to recalibrate pumps that deliver the neutralization chemicals to the tanks. The pumps for the same chemical do not deliver the same rate of addition, which is a source of variation between the neutralization of different batches. Recalibration would prevent excess chemical additions by pumps running faster than intended. Saving are likely small but so is the recalibration cost.



Check Pipe Orifices

The third recommendation is to check pipe orifices in the neutralization tank, recirculation line, to ensure all the mixing ports are free of blockages. Again small savings and small cost.

Introduce Pause Before Set Point Limit

Finally, adding a short pause to chemical additions shortly before reaching the set point limit shows promise, but work was not completed to fully characterize this change in procedure or to determine its impact.

Recommendation	Annual Reduction	Annual Savings	Status
Self-neutralization	34,000 lbs SBS 80,000 lbs Bleach 26,000 lbs NaOH	$12,000	In Progress
Recalibrate pumps	4,000 lbs NaOH	$300	In Progress
Maintenance on tank mixing	430 lbs SBS 300 lbs Bleach 290 lbs NaOH	$90	In Progress

MnTAP Advisor: Karl DeWahl, Senior Engineer

City of New Prague

Emily Wen,
Chemical Engineering,
Washington University, St. Louis

Company Background

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

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

Project Background

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

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

Incentives To Change

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

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

Solutions

Odor Scruber and HVAC Reduction

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

Reduce BAF Aeration

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

Seal Compressed Air Leaks

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

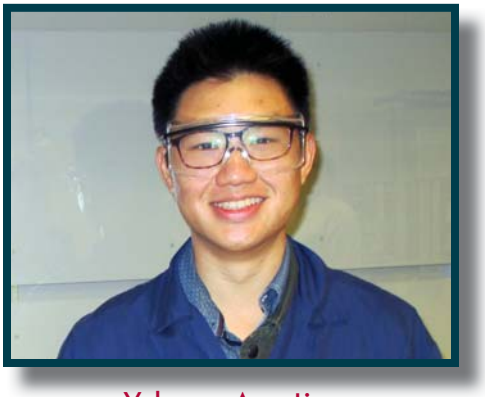
Upgrade to LED Lighting

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

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

MnTAP Advisor: A.J. Van den Berghe, Engineer

DiaSorin Incorporated



Yohanes Agustinus,
Chemical Engineering,
University of Minnesota, Twin Cities

Company Background

DiaSorin, Inc, is an Italian biomedical company developing, producing and commercializing diagnostic tests for a wide range of clinical areas in the markets of immunodiagnostics and molecular diagnostics. The Stillwater, MN facility, produces and distributes the kits around the world.

"I've always been passionate about pushing for a greener chemical industry, and this program has allowed me to use my engineering skills to realize large water savings that make both economic and environmental sense. This internship has exposed me to thinking creatively for opportunities to reduce wastage, and how to navigate office dynamics, and push recommendations towards successful implementation. These skills will better equip me to enter the workforce as a full-fledged engineer." ~ YA

Project Background

Based on water utility bills for the 2015-16 year, DiaSorin consumes approximately 8.5 million gallons per year of water both for its manufacturing and domestic needs. This water is purchased from the City of Stillwater. At the beginning of this project, 37% of incoming water was unaccounted for and a major goal was to account for the unidentified water use. In quantifying more of the water use footprint, water reduction strategies emerged that would reduce water use, sanitary sewer costs and potential sewer availability charge (SAC) increases.

The project was divided into 2 stages; first, major water-consuming areas in the facility were identified, and second, possible water reduction strategies were proposed.

Incentives To Change

A better understanding of water use was desired in order to pursue the most prudent opportunities for water reduction. Overall water supply and sewer costs were significant and the potential for assessment of additional SAC units prompted DiaSorin Inc. to look closely at water conservation with a MnTAP intern.

"This is the first time that DiaSorin teamed up with MnTAP to sponsor an intern, and it was a huge success! The intern was professional, well prepared and organized. He stayed focused on mapping resource usage, collecting and analyzing data, and identifying ways to reduce resource consumption. MnTAP's internship program is a great benefit for interns and Minnesota businesses alike."

~ Kelly Gilliland, EHS Manager, DiaSorin

Solutions

Repairing Leaks and OptimizingVacuum System

DiaSorin utilizes a liquid ring vacuum pump to provide 24 inches mercury (Hg) of vacuum for the entire facility. Vacuum is used for benchtop and fume hood filtration, as well as for pouching (vacuum packing of diagnostic kits). A new water supply meter identified 24/7 water leaks that prompted installing a new flow meter and new solenoid valve on the vacuum pump system.

Installing Ultra-low Flush Toilets

Installing ultra-low flush toilet bowls reduces domestic water consumption due to flushing of toilets by up to 20%. Toilet flushing is approximately 50% of domestic water consumption based on research and assumptions made at DiaSorin.

InRecycling Reverse Osmosis (RO) Water for Hot Water Make-up

RO concentrate can be recycled into the hot water line in Buildings 3 and 4 at DiaSorin. The RO concentrate, having been previously softened in ion-exchange columns, have effectively zero hardness, meaning low probability of lime-scale formation on glassware and buffer tanks. A pilot experiment should be conducted to ascertain any differences in cleanliness of glass ware and tanks between a city water and RO concentrate wash.

Optimize the Irrigation System

Current clock-based controllers at DiaSorin can be replaced by more effective smart technology controllers to save a potential 50 percent in irrigation water use.

Proper Control of Hot Water Hardness Levels

Hot water is conditioned by ion-exchange to maintain a low hardness range. It was determined that cold water was tied to hot water loops causing a need to routinely purge the water supply loop to maintain water quality. Installing check valves on eight system sinks and implementing a hot water hardness monitoring plan is recommended.

An additional energy conservation aspect was also explored Some fume hoods in the facility run continuously, meaning conditioned air (cold in summer, hot in winter) is continuously lost from the facility. Proper control of these exhaust points by installing timers can save energy by reducing exhaust fans working time, reduce loss of heat during summer, and reduce cooling tower load in summer (potentially saving water as well). Less air would also need to be re-conditioned to maintain positive pressure in the building.

Recommendation	Annual Reduction	Annual Savings	Status
Solenoid valve leak elimination	977,600 gallons	$6,800	Implemented
Throttling flow through vacuum pump	2,200,000 gallons	$15,400	Implemented
On-demand vacuum system	522,300 gallons 28,000 kWh	$5,200	Implementing
Recycle RO concentrate for hot water make-up	26,000 gallons	$180	Further analysis needed
Upgrade to ultra-low flush toilet bowls	747,500 gallons	$5,200	Recommended
Install smart irrigation controllers	403,800 gallons	$570	Recommended
Replace check valves and faucets in hot water line	15,600 gallons	$1,400	Recommended

MnTAP Advisor: Michael Jost, Senior Engineer

Electric Machinery Company

Brady Halvorson,
Environmental Engineering,
University of Minnesota, Twin Cities

Company Background

Founded in 1891, WEG Electric Machinery (WEM), part of WEG Group, custom designs and manufactures motors and generators that serve thousands of customers worldwide. Engineering cost-effective solutions for both simple and complex applications, they offer more than standard design- they build machines to their customer's exact specifications. WEG Electric Machinery combines experience and innovation to deliver consistency and reliability in every unit.

"What I have learned is that there is no perfect solution to a problem. In school, we are taught to seek out the 'right' answer when in reality there never really is one. Solutions come from hard working individuals who gather as much information as possible and try to deliver a system that eliminates waste while still producing the desired outcome." ~ BH

Project Background

Electric Machinery is currently using roughly 1.8 million gallons of water for cooling each year. The water is used to cool motors and generators during testing, and for cooling during welding. The current setup is single pass, non-contact water which is used for heat removal and then sent down the storm sewer. The company recognized the opportunity to save water in its cooling processes, and requested a MnTAP intern to look for solutions.

Incentives To Change

Electric Machinery Company recognized that single pass water cooling was inefficient and they sought a cost effective solution that would not only save water, but also time and money. Sending water down the storm sewer requires chemical treatment and special permits. The water also needs to be tested, documented, and reported monthly to the MPCA. This potential for water conservation and cost savings are the major drivers for this project.

"MnTAP allowed us to work on a identified project that we did not have the resources to focus on. Our intern was able to arrive at comprehensive and cost effective solutions. I would recommend the MnTAP program to anyone looking for support with environmental initiatives. With new solutions, there are many opportunities to benefit not only the environment, but also the business. We will likely be identifying additional projects and utilize the program again."

~ Nick Bergman, Continuous Improvement, Electric Machinery Company

Solutions

Eliminate Water with Air-cooled Heat Exchangers

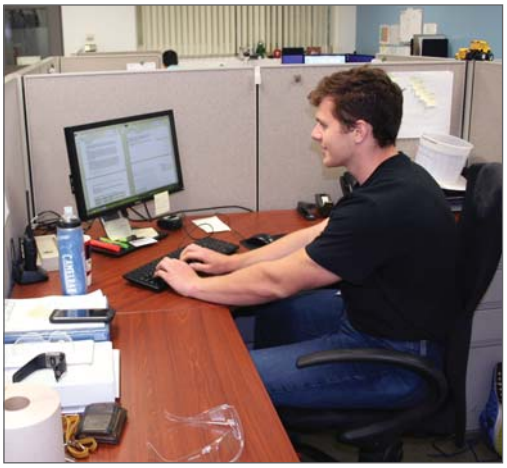
Many of the current water cooled heat exchangers can be swapped out for electric air-cooled heat exchangers. These are less expensive to run, and result in zero water discharge for this process. In time, each of the water cooled heat exchangers will be upgraded to completely eliminate water use for non-contact cooling. For now, there are several specific areas that use more water than others and these areas should be upgraded first. Specifically, large quantities of water are used to cool the 12.5 gearbox and generator and the Elliot generator. These two processes alone contribute to nearly 40% of the average annual cooling water use, using roughly 700,000 gallons per year. Implementing this project will result in a water cost savings of $6,400 per year.

Eliminate Water with Recirculation and Chillers

Another major area of water usage is the spot welder. On average, the spot welder uses about 700,000 gallons of water annually which is another 40% of the total water used for non-contact cooling. It is important to maintain the proper temperature in a spot welder to avoid damage to the machine. The best solution to save water here is to install an air cooled water chiller next to the machine so it can provide water at a consistent temperature and flow to ensure proper cooling. This water will recirculate through the spot welder to cool it, and will then flow back through the chiller to be cooled. Not only will this reduce water usage but it will provide more precise cooling for welder.

Install a Water Chiller for Enclosed Motor Testing

The last area that can be improved to reduce water usage is the tempering tanks used for the totally enclosed water-air cooled enclosures (TEWACs) and the lube systems used for the turbo generators. These processes are not used frequently, but have a large water load during operation. Currently, the tempering tank is used to pump water through the TEWAC enclosures to control the temperature of air inside. The tank is filled with water that is temperature regulated by dumping hot used water and drawing in fresh cool city water. The solution to reduce water is to install a water chiller to regulate the temperature of the water in the tempering tank. The chiller will draw water out of the tank, cool it, and then send it back to the tank. This tank will then be connected to the turbo lube systems to recirculate the water for cooling in these areas as well. In this way, there will be very little water consumption in these areas and Electric Machinery will make better use of equipment that they already own.



Automatic Flow Meters for Accurate Dosing

The non-contact cooling water used at Electric Machinery is treated before being sent to the storm sewer. The treatment removes chlorine that is present in tap water, but is unwanted in rivers and streams. The current dosing system is using more treatment chemicals than necessary to treat the discharge water, which is costly. The solution is to use an automated dosing system that will measure chlorine quantities in the water and vary treatment in real time to reduce the chlorine load. This automated system will save 390 gallons per year in sodium bisulfite, for a $4,600 per year cost savings based on existing water discharges.

Recommendation	Annual Reduction	Annual Savings	Status
Automated chemical dosing	390 gallons sodium bisulfite	$4,600	Implementing
Install air cooled heat exchangers	950,000 gallons	$9,000	Implementing
Water chiller for spot welder	700,000 gallons	$6,600	Implementing
Water recirculation for machine enclosures	130,000 gallons Labor and permit fees	$8,400	Planned

MnTAP Advisor: Jon Vanyo, Assoc. Engineer

Fulton Beer Company

Karl Wuolo-Journey,
Chemical Engineering,
University of Minnesota, Twin Cities

Company Background

Fulton Beer started out as a local homebrew operation in a south Minneapolis garage in 2006, then was formally founded in 2009. In less than a year, Fulton beer was in over 100 bars in the Twin Cities. In 2011, Fulton built Minneapolis' first taproom/brewery at their 20 bbl production facility. Within two years, Fulton had maxed their taproom's production capacity, so they purchased a building in NE Minneapolis and retrofitted it into an 80 bbl production facility. Currently, Fulton has reached production capacity of 33,000 bbl/year brewing five beers year round with another 26 seasonally. Their distribution spans throughout the Midwest and plans to reach the east coast within several years.

"Working with Fulton Beer Company was a great and educational experience. It was great learning about the brewing process and how to make it more sustainable. This experience has greatly furthered my skills as an engineering student, and my ability to approach a problem critically to come up with creative solutions. I am gratefull to MnTAP for giving me the opportunity to apply my engineering skills in the field and I'm confident that the experience I gained will be an asset throughout my career." ~ KW-J

Project Background

Fulton uses water supplied by the city of Minneapolis. This water is dechlorinated to prevent degradation of their stainless-steel brewing equipment and then used in for beer production, floor, tank, and packaging rinses, and lubrication for conveyor lines. Fulton is aware of their high water usage and has manufactured equipment to help reduce their consumption. This includes several process lines that recycle used cooling water into their hot liquor tank. In addition, Fulton has made efforts to minimize and recycle their rinse water. Fulton has also built a basic pretreatment system to remove solids and neutralize the pH of their high strength effluent. Although they have implemented several means to reduce their recourse consumption, there was still much room for improvement.

Incentives To Change

The brewing Industry is a highly water intensive process. A craft brewer can use anywhere between four and nine gallons of water to produce a single gallon of packaged beer. Much of this water is heated water, making the process even more energy intensive. Fulton will likely use over 5,000,000 gallons this year. In addition, the brewing industry produces a lot of high strength wastewater. This water contains high levels of organics and solids, such as yeast, spent grain, and alcohol which contribute to the total suspended solids (TSS) and chemical oxygen demand (COD) of the effluent. This water is expensive to treat. As such, the Metropolitan Council, the regional wastewater treatment organization has issued surcharges based on effluent strength and volume to breweries to help pay for the water treatment. Fulton wanted to investigate ways to reduce their effluent strength and water usage, thus reducing costs and making their company more sustainable as they continue to grow.

"During Karl's internship, he identified areas of improvement on water consumption, waste water surcharge reduction, and boiler efficiency. He explored many engineering solutions for each problem and we are confident he found the most economical and dilligent process for us. We are grateful for his effort and will use his knowledge towards operating as efficiently as we can."
~ Paul McDonald, Plant Manager, Fulton Brewing

SOLUTIONS

Water Reuse for Bottling Line Vacuum Pump

To increase beer shelf life, a liquid ring vacuum pump is used on the bottling line to evacuate air and CO_2 from the bottles before filling. The water in the pump heats up during operation, which reduces the vacuum. Warm water is discharged from the pump and replaced with fresh cooler city water at a rate of 5.25 gal/min. By adding an appropriately sized heat exchanger with a glycol loop, Fulton could

Solutions

cool and reuse the vacuum pump water. This would save up to 220,000 gallons per year. If Fulton does not install a recirculation loop on their vacuum pump, they should install a reclamation vessel next to the bottling line. This vessel would capture all the pump discharge and store it for use in floor rinses, fermenter clean in place (CIP) operations and additional spray rinses on the bottling line.

Canning Line Rinse Water Reduction

Fulton was using clean city water for both internal and external rinses on their canning line. Rinses are performed to remove any particulates on the inside of cans, and beer and foam on the outside. Because the cans are largely clean, the internal rinse water is suitable for external rinsing. The supply and demand of these two rinses were balanced by replacing low efficiency, high volume sprayers for the external rinse with high efficiency nozzles. The flow rate can continue to be fine-tuned with a needle valve to minimize water consumption. Reclaiming and reusing this water will save Fulton over 150,000 gallons per year in city water usage.

Replace Broken Valve on Kegging Line

All the rinsing bays in the kegging line have makeup water lines to compensate for water loss during operation. The makeup water is controlled with float valves. A broken valve on a caustic bay caused unnecessary hot water to be added, which overflowed strait to the drain. Fixing this valve will save Fulton 74,000 gallos per year of hot water and 540 therms for heating.

Evaporate Yeast & Trub Water-mix with Spent Grain

During fermentation, dead yeast and hops (cold trub) collect at the conical bottom of the fermentation vessel. When the beer is transferred to another fermenter or bright tank, all the yeast and hops at the bottom are drained out. These dumps contain the highest concentration of TSS and COD and are also the largest sources of TSS and COD in the effluent. A usual dump is between 300 and 500 gallons and when combined with the hot trub from the brewhouse, it can be responsible for up 2/3 of the total effluent strength charge. Instead, it can be side streamed to an evaporator, reducing its moisture content, mixed with spent grain, and sold as animal feed. This will drastically reduce Fulton's wastewater strength charge and generate additional revenue.

Install Flatjet Nozzles in Kettle

After beer is transferred to the fermenters, there is a large pile of hops (hot trub) left in the kettle. This material is high in organics and solids. To remove this, brewers use large amounts of water to fluidize the trub and spray it towards the drain. The trub is mixed with grain at the end of the night and the water is raked out. Fulton can install high efficiency flatjet nozzles to slide the trub to the drain. Installing these nozzles will reduce water consumption up to 41,000 gallons per year, and help minimize the volume of solids and organics entering the sewer, thus saving Fulton money on their strength charge.

Add Insulation to Boilers

Fulton has two low pressure steam boilers used for production. The boilers have uninsulated head plates that are typically at 240° F. These plates radiate enough heat to elevate the boiler room temperature up to 130° F. Not only does this cost money, but it also makes working in that room unbearable.

Recommendation	Annual Reduction	Annual Savings	Status
Bottling line vacuum pump water reuse	220,000 gallons	$2,200	Recommended
Canning line rinse water reduction	150,000 gallons	$1,500	Implemented
Kegging line broken valve replacement	540 therms	$1,100	Recommended
Evaporator for fermentation waste	115,000 lbs solids	$9,200	Recommended
Install flatjet nozzles in the kettle	41,000 gallons	$400	Testing
Insulation for boiler head plates	1,600 therms	$1,000	Recommended

MnTAP Advisor: Michelle Gage, Assoc. Engineer

Kerry Ingredients

Denzel Bibbs,
Mechanical Engineering,
University of Wisconsin-Madison

Company Background

Kerry Functional Ingredients & Actives in Rochester, MN, specializes in fermented and cultured ingredients. The Rochester plant is one of multiple facilities that make up the Kerry Group, a global food company. What makes the Rochester facility unique, is the process of creating products through fermentation, which are then converted to solid form through the use of spray dryers. Kerry finds great value in the ability to deliver high-quality fermented products in dry form to its customers, such as a cultured celery product often used in meat curing.

"It is great to see a global company like Kerry with comprehensive sustainability goals. Through MnTAP, I was able to make recommendations that will advance Kerry's progress toward their sustainability goals. The coordination between Kerry and MnTAP will have a positive impact on Minnesota's environment." ~ DB

Project Background

Along with on-going company-wide goals, there are additional incentives to come up with solutions and increase efficiency of operations at the Kerry Rochester plant. The plant is currently undergoing a major expansion project. The increase in production capacity will demand more water, electricity, natural gas, and raw materials for plant operations. New boilers and additional water services will be needed to accommodate the expansion. A large focus of the MnTAP intern project for Kerry was to find opportunities to minimize the need to increase steam and water capacity, and to help Kerry staff make decisions on the purchase and design of new equipment. The MnTAP intern project was intended to help make appropriate decisions on equipment and process changes with a focus on optimizing the use of water, energy, chemicals, and reducing wastewater burden to the city treatment plant.

Incentives To Change

Kerry Group has a company-wide program called "Towards 2020," with set goals and targets to reduce environmental impacts of its global operations. Kerry is committed to reducing water use by 11% (compared to baseline year 2011 and a 13% reduction (compared to baseline year 2013) in greenhouse gas emissions by 2020. By focusing on energy efficiency, water conservation, and chemical optimization opportunities, Kerry Rochester will advance the global targets of the Kerry "Towards 2020" program.

"MnTAP has been a tremendous asset in helping Kerry identify opportunities to meet our sustainability goals. The intern program has delivered actionable project ideas that will be implemented in our upcoming expansion."
~ Brian Morgan, Project Engineer, Kerry Ingredients

Solutions

Closed Loop Cooling

Kerry currently uses a single-pass well water loop for cooling purposes. To reduce water consumption, the loop can be closed with a heat exchanger. The closed loop would be cooled using chilled water from the existing chiller. It is recommended that a water storage tank be added, and makeup water for the closed loop would be supplied by city water or reverse osmosis (RO) water. This implementation would eliminate the need of having the well water pump in constant operation. This system would significantly reduce water use by reusing the well water for cooling, instead of discharging it after a single pass.

Equalization Tank

Kerry Ingredients currently utilizes a sewer pit to balance the pH of outgoing wastewater, before it is sent to the city water treatment plant. Though this system is somewhat effective, there is an opportunity to treat the outgoing wastewater much more effectively. The nature of the current sewer pit makes it difficult to control the pH when caustic and acid chemicals are added in an attempt to neutralize. The installation of an equalization tank would improve the pH neutralization process, largely due to improved agitation and more control over caustic and acid chemical additions within the installed tank. The increased control over chemical additions will increase the effectiveness of both caustic and acid chemicals. The results are a reduction in use of these chemicals and the corresponding cost savings.

Improve Steam Traps

Steam traps are valves used at the Kerry facility to filter out condensate and regulate the steam system. Many steam traps throughout the plant are clogged with debris from steam line corrosion. Different types of steam traps are available that vary in effectiveness, depending on different characteristics of the system. To improve steam trap operation, the orifice type steam traps on steam mains used in the plant should be replaced with bucket type steam traps. Bucket steam traps are a better design to handle debris. Maintaining steam traps that are clear of debris would improve the condensate returned to the deaerator tank, reducing natural gas and water use.

Reverse Osmosis

Implementing a reverse osmosis (RO) system would reduce the total dissolved solids (TDS) of the boiler makeup water. Removing TDS from the water would reduce the boiler blowdown from 10% to 2%. Though an RO system will require about 20% of the water to be rejected, reducing boiler blowdown will help offset the water increase and will reduce natural gas usage. It would also result in cleaner heat transfer surfaces, increasing equipment longevity. Though it has yet to be quantified, the amount of water treatment chemical used for maintaining boiler conductivity levels would decrease, as well.

Recommendation	Annual Reduction	Annual Savings	Status
Closed loop cooling	200 million gallons	Further review needed	Recommended/Under review
Reverse osmosis	68,100 therms	$30,800	Implementing
Steam trap replacement	118,300 gallons 1,910 therms	$1,125	Further review needed
Equalization tank	16,600 lbs caustic 9,400 lbs sulfuric acid	$8,400	Implementing

MnTAP Advisor: Matt Domski, Organic Waste Specialist

Phillips Distilling Company

Nathaniel Scherer,
Chemical Engineering,
University of Minnesota, Duluth

Company Background

Phillips Distilling Co. started in 1912 as a candy and magazine distributor that grew to become America's largest alcohol distributor by 1945. Today, Phillips produces a large variety of popular, high-quality alcoholic beverages. Some of their most popular brands are UV, Phillips, and organic Prairie vodka. Their headquarters is in Princeton, MN where alcohol is distilled, flavored, blended, bottled, and packaged for shipping. Today, the Phillips plant in Princeton employs over 275 people and ships 7 million cases annually.

"Everyone at Phillips was committed to helping me reduce energy and wastewater, which made this a fun and successful project. I learned a great deal about both industry-tailored sustainability solutions and real life production practices. I really enjoyed this rewarding internship, and I know the experience will carry with me forever." ~ NS

Project Background

Products are blended and stored in large tanks before being sent to a production line to be bottled and packaged. All equipment on the production line utilizes compressed air, making compressed air a large, crucial, expensive utility. It is important to optimize such a large system to maximize compressed air efficiency. Due to the nature of the bottling process, there are high flows of wastewater from cleaning tanks and piping. Because of its high sugar content and alcohol levels, this wastewater is expensive to dispose. Finding ways to reuse and minimize water usage will also minimize water discharge, providing significant savings.

Incentives To Change

Phillips created a sustainability committee, "One Team: G.R.E.E.N." to carry out their goal to move toward a more sustainable culture. This team saw a great opportunity to be environmentally responsible and reduce costs by improving their compressed air systems and minimizing water usage and discharge. Facility wide, compressed air costs more than $90,000 annually while industrial wastewater discharge costs are $280,000 annually. With plans to continue expanding, it is important that Phillips develops methods to improve their compressed air efficiency, reduce and reuse their water throughput.

"We wanted an outside source with experience and knowledge to help us reduce costs and our carbon footprint. Our Sustainability program includes a key value to have positive impact on the community. Having an intern to work toward our goals has allowed us to focus on key tasks. MnTAP is well thought out, supported, and executed, allowing companies to better themselves and the community while offering work experience to our emerging workforce. We will definitely look to using this resource for future projects."

~ Larry Jurik, Manufacturing Technical Manager, Phillips Distilling

Solutions

Leak Prevention Program

As part of the compressed air audit, 35 leaks were identified and a plan was developed to fix them. Phillips purchased an ultrasonic leak detector, and implemented the "Leak Prevention Program" which named several leaders from different departments as "Leak Champions." These champions are responsible for holding each other accountable for identifying, reporting, and fixing leaks. This largely includes awareness and training. Implementing these improved compressed air maintenance procedures should save up to $15,500 annually.

Regulating Air Use

Improving procedures and training for minimizing air use will yield high savings. If equipment is shut down but the air supply valves are left open, air continues to flow like a large leak during periods of non-use. New shutdown procedures will reduce this air waste in most cases, though for certain equipment automated valves may be required. This will save up to $14,000 annually. New procedures to raise awareness on air costs, time, and regulation of all air used for tank agitation could save up to $3,000 annually.

Pressure/Flow Controller

Equipment requires air supply at 90psig, but system pressure fluctuates from 76 to 126psig. Thus, compressor must supply higher pressure air to compensate for potential pressure drops. A pressure/flow controller will moderate pressure throughout the compressed air system so that the compressor can be set to supply air at a lower pressure without the system falling below the 90psig required by equipment. Lower pressure air takes less energy to produce, providing about 1% energy savings for every 2psi reduction- in this case, approximately $3,700 annually.

Install Electric Dunnage Bag Blowers

Dunnage bags are inflated and placed between pallets to reduce vibration during shipping. A 25 hp compressor currently supplies air exclusively to dunnage bag blowing. An electric blower could be used to quickly inflate the bags with low pressure air and completely eliminate the need for this compressor. Phillips could purchase an electric blowers to replace the current system and would save $1,000 per year.

Replace Tank Rinse Spray Balls

Tanks are currently rinsed with stationary spray balls where pressurized water is scattered through orifices to cover the walls inside the tank. Current spray balls have high volume flows with low pressures, making rinses take longer and require more water. Replacement spray balls have smaller orifices and therefore provide more pressurized water and is more efficient at cleaning tanks. By design, these new spray balls also rotate with fluid flow to maximize their effectiveness. In practice, these new spray balls save around 50% of tank rinse water, or approximately 156000 gallons per year.

Reusing Final Rinse Water

Tanks are rinsed several times until the rinse water meets quality specifications that dictate the tank is clean and ready for another product. This clean final rinse has very low amounts of contaminants and could easily be used is other applications, such as first tank rinses or water to flush product out of transfer piping. With opportunity to reuse 160,000 gallons annually, implementation strategies for capturing and storing the rinse water are still being investigated.

Recommendation	Annual Reduction	Annual Savings	Status
Leak prevention program	158,000 kWh	$15,500	Implemented
Regulated air use	186,000 kWh	$18,100	Implemented
Pressure/flow controller	38,000 kWh	$3,700	Recommended
Electric dunnage bag inflators	11,000 kWh	$1,000	Recommended
Insulating boiler water pipes	10,000 therms	$6,000	Implemented
Reusing low-proof final tank rinse water	160,000 gallons	>$10,000	Investigating
Replacing tank rinse spray balls	156,000 gallons	>$9,000	Implemented

MnTAP Advisor: Michelle Gage, Assoc. Engineer

Phillips Neighborhood Businesses

Madeline Norgaard,
Science, Technology, & Environmental Policy, University of Minnesota Twin Cities

Company Background

The Phillips community is made up of four unique neighborhoods located in South Minneapolis. Spanning 1.6 square miles, Phillips is home to 20,000 residents who come from all over the world. The variety of economic activity of the area is impressive, due in part to the prosperity of small businesses. Hope Community, a nonprofit community development organization, works to empower residents through a variety of programming, including youth development, healthy food access, and equitable housing. Despite decades of revitalization efforts, the Phillips community remains one of the most environmentally overburdened and economically vulnerable areas of Minneapolis. In particular, the increased risk of health issues due to air pollutant exposure in the Phillips community motivated this project.

"Working to reduce air pollution from non-regulated sources is no easy task, yet I was impressed by the willingness of small businesses to try out new products in an effort to improve air quality for their employees and surrounding community. I learned that when provided the opportunity, and necessary information and incentives, businesses are eager to take voluntary action to protect the environment. Clear communication, providing the right level of assistance, and lowering barriers to change were essential to this process. Despite having a relatively smaller environmental impact, action from small businesses is vital to ensuring a safe environment for all." ~ MN

Project Background

Prior to this project, MnTAP engineers established what it means to classify cleaning and degreasing products against safety for the environment and human health. A pilot project was then conducted which helped determine that safer products are functionally equivalent to less safe products. This project was initiated to leverage MnTAP's knowledge and resources by motivating broader adoption of safer products that work well.

During the first month of this project outreach efforts were conducted to introduce the project purpose and the benefits of participation. Site visits to interested businesses were conducted to record information about products currently in use. This information was used to analyze the safety of current products using safety data sheets and MnTAP resources. Safer alternatives available at local auto parts retailers were identified and analyzed in a similar manner. Then, samples were purchased and given to auto shops to test for functionality. After one to two weeks follow up visits were conducted to see how mechanics liked the sample provided. If they were satisfied with the sample performance and verbally agreed to change products, a case of products was purchased for the business to try out for a longer period. If the samples were not up to par, other alternatives were identified and tested.

Incentives To Change

This summer, automotive shops in the Phillips community of South Minneapolis were presented the opportunity

"Air quality is an extremely important issue in the Phillips Community of Minneapolis, as the neighborhood has long suffered adverse environmental impacts from policy and land use decisions. Hope Community has been in Phillips over 40 years, so the opportunity to host a student working to improve air quality by connecting with area businesses was a natural fit. Maddie was tremendous at making connections with small business owners, quickly building trust, and getting folks on board with the idea of switching products to benefit the local environment. We were extremely happy with both her approach and the results of her outreach work. "
~ Will Delaney, Associate Director, Hope Community

to improve worker safety and public health by switching to safer cleaning and degreasing products. Typically, cleaning and degreasing products emit harmful amounts of hazardous air pollutants, volatile organic compounds, and ground-level ozone which contribute to poor air quality. Locally, poor air quality affects Minnesotans by triggering a range of short and long-term health problems, from itchy throats to asthma attacks. It also contributes to smog and acid rain, leading to contamination of water bodies, crops, and other natural areas. Because one-third of air pollution emissions in Minnesota come from distributed and/or unregulated sources of pollution, this project aimed to promote the broad adoption of safer cleaning and degreasing products commonly used at auto shops through direct outreach and technical assistance.

Recommendations

Recommendations were made based on three values assessed for each product: hazardous air pollutants (HAPs), Volatile Organic Compounds (VOCs) and ozone producing potential (ozone number). Products identified as safer will have lower HAPs, VOCs, and/or ozone numbers. Choosing safer products is not easy simply by looking at product labels. Products can look very similar, but can vary greatly in level of safety for health and the environment. Product part numbers were used to search online for safety data sheets (SDS) which list product ingredients and other helpful information.

Products

Products that contain hazardous air pollutants (HAPs) were avoided. HAPs such as xylene, toluene, ethyl benzene and methanol can cause serious health complications in the people who work with them. Often the percentage of volatile organic compounds (VOCs) in the product can be found in the SDS, with lower numbers indicating higher safety. The pounds of ozone producing-potential per pound of product (ozone number) was estimated using ingredient weight percentages and maximum incremental reactivity (MIR) values. MIR values are a measure of ozone formation per unit weight of hydrocarbons added to the atmosphere.

Typically, ozone numbers of less than one indicate safer products. Without a thorough analysis there are some aspects to a label that can help consumers differentiate products: language such "non-chlorinated," "Low-VOC," "50 State-compliant" or "California Compliant" can indicate a safer product.

Lastly, emissions can be reduced by utilizing bulk cleaners and investing in refillable spray cans that are non-aerosol. However, due to the small size of auto shops in the Phillips community, most preferred individual spray cans for ease of storage and use.

Recommendation	VOC Reduction	HAP Reduction	Ground-level Ozone Reduction	Status
Switch to safer cleaning and degreasing products	450 lbs per year	860 lbs per year	1765 lbs per year	Implemented

MnTAP Advisor: Nathan Landwehr, Waste Reduction Specialist

Plastech Corporation

Emily Daniel,
Aerospace Engineering & Mechanics,
University of Minnesota, Twin Cities

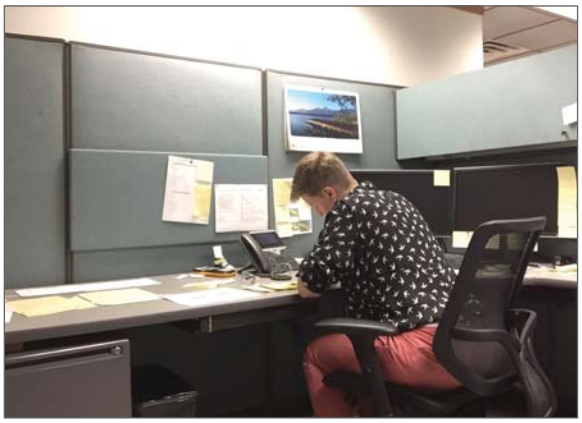
Company Background

The Frandsen Corporation began as a lumber company in 1951 and has grown into a major holding and management company that spans four states and manages seven different corporations. Dennis Frandsen started Plastech Corporation in Rush City, MN 55 years ago to provide a state-of-the-art facility for custom plastic injection molding. Driven by their motto to produce "perfect parts, on time, every time" Plastech has proven to clients across the nation that they care about customer and employee satisfaction, represent a high standard of excellence, and strive to grow while moving towards sustainability.

"Through this internship, I've learned how to better gather data and information from scratch, organize it into a cohesive manner, and analyze it against all possible solutions. This allowed me to put my engineering knowledge to practice and acquire valuable skills I would not have learned in the classroom. The great wealth of information provided by the staff at MnTAP and Plastech Corporation has taught me to internalize the concepts of energy efficiency and understand how they can be applied to any field while simultaneously giving me the experience of working in industry, and the confidence to pursue my own ideas. I am certain of my abilities to approach any problem with a new and unique perspective." ~ ED

Project Background

With 44 injection molding machines, mold heaters, and numerous pneumatic devices, Plastech wants to reduce their energy use by finding ways to reduce motor idle time, minimize compressed air use, and improve assembly workflows to better meet customer demands. While 90% of Plastech's scrap is reused in their process, the company is highly interested in finding ways to reduce, reuse, and recycle even more than they already do. The project focused on these areas to optimize energy, material waste, and create a leaner assembly process.



Incentives To Change

Plastech shows its committment to staff and customers by making continuous improvement a core part of its culture. This commitment has helped reduce the cost of unnecessary material waste and increased their ability to meet demands. Plastech has corporate goals to reduce material waste to under 4% and are well on the way to achieving this. Additionally, creating a more efficient process in terms of material utilized, energy consumed, and process layouts will not only help reduce Plastech's utility bills but also Plastech's environmental impact.

"Plastech has an internal commitment that continuous improvement is an important part of our culture. We need to remain competitive in our respective industry and utilizing outside resources such as the MnTAP Program are a beneficial and welcomed addition to our internal capabilities. Our experience over the summer has been very positive and has gained a lot of support from all areas of the organization."

~ Douglas Hoffbeck,
Director of Engineering, Plastech Corp.

Solutions

Reduce Motor Idle Time in Grinders and Presses

Currently, processes at Plastech allow for granulator machinery to run uninterrupted. Additionally, presses and mold heaters are shut down on a variable and project-dependent basis. Both require motors to idle for long periods of time and create a demand on the energy usage of the facility. Installing the Watt Wattcher 2000 on five granulators to monitor motor idle decreased the energy consumption by 556,000 kWh per year, and implementing a shift check sheet standardized the shutdown process of other equipment. These reductions will result in a total annual savings of $82,000.

Improved Material Handling

Currently, operators are in charge of running presses, clipping excess material from finished products, and regrinding this excess material. Moving the regrinding step to a central location with one operator will eliminate the remaining granulators and translate to an energy reduction of 692,000 kWh per year. The potential for materials to be contaminated would also be reduced, resulting in material savings of 27,200 lbs on an annual basis. Working with the material handlers and external companies, Plastech intern, Emily Daniel sold 109,000 lbs of excess material stored, and determined the potential of stream separating waste material for recycling. It is estimated that up to 104,000 lbs of material could be recycled annually.

Move Assembly Process

Daniel recommended that certain processes be moved to new locations to both consolidate the inventory, assembly, and shipping of one process while improving the flow and efficiency of two others and opening up a vast amount of space for the remaining processes to be rearranged. Additionally, she recommended that purchasing new equipment to optimize another process, would reduce ergonomic and physical constraints, increasing efficiency by 22-35%, and saving between $5,500 and $8,700 annually. The moves would reduce forklift use and save 2,600 gallons of propane gas, and save $26,300 from labor efficiency on an annual basis.

Reduce Compressed Air Demand

The intern found that by investing in a leak detector and scheduling semi-annual check-ups of the production equipment, as well as by implementing isolation valves on pneumatic equipment, up to 441,000 kWh could be saved annually, saving Plastech $23,000 each year. Several processes still using pneumatic equipment could be done with electric alternatives thus lowering energy demand. Each device switched would save between 8,000 and 13,000 kWh per year or between $400 and $700 annually.

Recommendation	Annual Reduction	Annual Savings	Status
Resale of excess and contaminated materials	109,400 lbs (1 time only)	$19,300	Implemented
Stream separation and central grinding	131,200 lbs	$13,800	Recommended
Watt wattcher 2000	556,000 kWh	$40,700	Implemented
Leak prevention program	441,000 kWh	$23,200	In Progress
Switch devices to electric	21,600 kWh	$1,100	Recommended
Relocate processes A, B, and C	2,600 gallons propane Labor efficiency increase	$3,000 $26,100	Recommended/ Implemented
Process D- improve ergonomics	22-35% assembly time	$5,500 - $8,700	Recommended

MnTAP Advisor: Michelle Gage, Assoc. Engineer

Seneca Foods

Daniel Chang,
Chemical Engineering,
University of Minnesota, Twin Cities

Project Background

Seneca Foods Corporation is a leading food processing and packaging company headquartered in Marion, NY. Founded in 1949, the company operates 24 plants across the United States in the West, Mid-West, and East, and employs 3,400 full-time workers and 8,000 seasonal workers as of 2017. Approximately 12% of packaging is done for Seneca-owned brands such as READ, Aunt Nellie's, Libby's, and Seneca. The remainder of the packaging is done for private labels and other food distributors. Some of the products produced include three-bean salad, whole kernel and cream-style corn, peas, and a variety of beans including wax beans, green beans, and Italian beans.

SENECA
Farm Fresh Goodness Made Great

"Finding improvements is a mindset. If you have that mindset, you begin to develop an eye for seeing problems and their solutions everywhere." ~ DC

Project Background

The objective was to reduce solid waste at the Rochester facility. Solid waste can occur for a number of different reasons, including: washing the product, transportation across the plant, and improper can sealing or cooking. By quantifying the loss of good product during the various stages of processing, recommendations could then be made to improve production retention in areas of high loss. An additional project goal was to inventory chemicals used in production to identify areas for potential reduction.

Incentives to Change

In 2016, Seneca established a product recovery program, aimed at maximizing the amount of product that ultimately becomes either canned or frozen. The MnTAP intern project goals of reducing food waste, while improving the efficiency of water, chemical, and energy usage, aligned well with the objectives of Seneca's company-wide recovery program.

"The fact that you aren't where you want to be should be enough motivation to change. The ones who are crazy enough to think that they can change the world are the ones who do. The MnTAP Internship program provides our company the competitive edge it needs by discovering processing wastes while promoting change to reduce operational costs. Always aiming to be environmentally friendly, this has reduced our water usage, chemical water treatment, product loss, electrical demand, and industrial silage waste."

~ John Sigrist, Production Supervisor, Seneca Foods

Solutions

Continue Using Display Monitors to Adjust Color Sorter Efficiency

Seneca's production process utilizes multiple stages to sort out good quality product from the bad. An objective of the intern project was to rank the sorting stages and corresponding equipment, in terms of how much good product was being lost. From measurements of the different stages, it was found that high-speed, optical sorting machines referred to as Color Sorters, were responsible for the highest loss of good product. Improving control of the Color Sorters became a key project goal, with a target for a 50-50 ratio of good product to bad product in the waste stream from the Sorter. Maintaining this setting was accomplished by installation of display monitors on the production floor, which were updated daily to show each Sorter's performance. By displaying this information in highly-visible areas of the plant, Color Sorter technicians were able to identify and adjust each individual Sorter to the correct settings, if the data showed it was out of target. This implementation was determined to save 18 tons of peas by the end of pea production.

Fill and Close

One of the stages during processing at Seneca involves filling and closing cans of product. Potential improvements were identified at this "fill and close" stage. These improvements consisted largely of increasing the height of existing guide walls and adding additional guide walls on each filler. The purpose of guide walls is to control product trajectories when transferred between different pieces of equipment, ensuring that product remains in the filling line and does not end up on the floor. Additionally, installation of conveyer belts is suggested to more effectively return spilled product into the fillers.

Defoamer Chemical Usage

A defoaming chemical is used throughout the plant as a means of controlling foam in water tanks. Water tends to build up foam as it circulates peas throughout the plant, which causes the water tanks to overflow. The current system provides inadequate control to the majority of the water tanks located inside the plant, and several tanks in the pea receiving dock. This has led to the regular practice of dumping pails of chemical straight into over-foaming water tanks, which is ineffective and contributes greatly to wasted chemical. With the addition of an improved dosing pump and new tubing to provide better foam control, the plant has the potential to save almost 15,000 lbs. of defoamer chemical per year.

Recommendation	Annual Reduction	Annual Savings	Status
Continue using display monitors	33 tons peas	$33,000	Implemented
Increase height of guard walls	4.5 tons peas	$4,500	Recommended
Add conveyor belts	8 tons peas	$8,000	Recommended
Implement worker training	9,900 lbs chemicals	$7,000	Recommended
Upgrade dispensing system	5,000 lbs chemicals	$3,500	Recommended

MnTAP Advisor: Matt Domski, Organic Waste Specialist

SkyWater Technology Foundry

Brandon Noel,
Electrical Engineering, University of Minnesota Twin Cities

Project Background

SkyWater Technology Foundry is a designer and manufacturer of semiconductor products for many industries, including a special accreditation for manufacturing US government microelectronics. They have 80,000 square feet of cleanrooms that are in use 24 hours a day, seven days a week, 365 days a year. Some common products include automotive chips and touchscreen controllers. They also produce products for niche applications such as quantum computing and DNA sequencers. SkyWater was previously owned and operated by Cypress Semiconductor from 1991 to 2017. In March of 2017, Cypress sold this facility to the newly incorporated company: SkyWater Technology Foundry.

"My experiences at SkyWater have made me feel much more confident in learning new sides of engineering and ultimately becoming a more well-rounded engineer. A big lesson I learned was that even small gestures of good faith can go a long way towards gaining the respect of technicians, whose buy-in is critical." ~ BN

Project Background

The energy usage at SkyWater is concentrated into two main areas: process equipment and ancillary equipment. The process equipment is effectively a constant load throughout the entire year and consists of the equipment to turn the raw silicon wafers into integrated circuits. The ancillary equipment load fluctuates based on the weather and includes systems such as de-ionized water, compressed dry air (CDA), liquid nitrogen, heating, ventilation, and air conditioning (HVAC), electrical, and life safety. The HVAC load fluctuates seasonally based on the outdoor ambient weather conditions since the cleanrooms have strict set points for temperature and relative humidity. The 80,000 square feet of cleanrooms require five air changes per minute, resulting in significant HVAC energy costs. SkyWater wants to reduce their HVAC energy costs.

Incentives to Change

SkyWater Technology Foundry uses a great deal of energy because of the energy-intensive manufacturing processes operating around the clock, 365 days a year. In 2016, SkyWater used 83.3 gigawatt hours (83.3M kWh) of electricity. 83.3 gigawatt hours of electricity is slightly more electricity than the amount that would be generated by the world's largest wind turbine, which is 722 feet tall and 538 feet in diameter, operating at constant maximum capacity for a year. Following the cost of labor, electricity is their largest cost. Operating more efficiently and reliably is therefore a high priority to keep SkyWater competitive with the rest of the semiconductor manufacturing industry.

"Having the MnTAP intern working at SkyWater has allowed us to understand and reduce our energy use while maintaining the air quality in a class 10 cleanroom. The new understanding and maintenance plan implementation will be remembered for years."

~ Bill Groboski, Staff Equipment Engineer, SkyWater Technology Foundry

Solutions

Clean Make-up Air Coils

The coils in the make-up air units transfer heat to and from the make-up air. At the start of the project, the coils were coated in dirt and debris. Dirty coils caused the make-up air units to work harder to condition the same amount of air at the required temperature and humidity. By cleaning the coils with pressure washers and hot water, the fans and the heat transfer fluid pumps can slow to their nominal values.

Reduce Condenser Water Pump Speed

The condenser water pumps are the part of the chiller system that cycles the condenser water through the condensers, cooling towers, and sumps. The current American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) guidelines suggest that a flow rate of two gallons per minute (GPM) per ton of refrigeration is the most efficient operating point. Currently, the pump speed isn't controlled to GPM per ton. This means the GPM per ton fluctuates based on the load, and does not consistently operate close to the efficient two GPM per ton recommended value. Installing flow meters to each chiller allows the pump speed to be controlled to the two GPM per ton operating point.

Recommendation	Annual Reduction	Annual Savings	Status
Clean fab A/B & C makeup air unit (MAU) heat transfer coils	71,000 kWh	$4,800	Implemented
Remove charcoal filters MAU A/B	13,000 kWh	$900	Implemented
Reduce fab C condenser water pump speed	480,000 kWh	$32,600	Recommended
Reduce fab A/B condenser water pump speed	540,000 kWh	$36,700	Recommended

MnTAP Advisor: A.J. Van den Berghe, Engineer

Smith Foundry Company

Al Muntasar Al Busaidy,
Mechanical Engineering,
University of Minnesota, Twin Cities

Project Background

Smith Foundry Company, located in the Phillips community of Minneapolis, specializes in low/medium production of ductile and grey iron using sand as molds and cores to shape their castings.

SMITH FOUNDRY CO.
Practical experience. Innovative design.

"The MnTAP internship gave me the opportunity to learn a new manufacturing industry and understand my weaknesses and strengths. Contrary to class problems, the challenges there were open ended and difficult to tackle. It was fascinating to see how small changes could have substantial outcomes in the past and current projects. Overall, a great experience that I will carry with me through my career path." ~ AA

Project Background

Smith Foundry Company is looking for means to improve air quality inside and outside of the foundry. This includes switching to a greener binding system for core-making to reduce volatile organic compounds (VOCs), hazardous air pollutants (HAPs), carbon monoxide (CO), and particulate matter (PM), and reducing silica exposure by optimizing silica sand handling. In addition, the company is looking into implementing new technologies to reduce operation costs and waste such as Furness-Newburge Sonoperoxone Blackwater system and Mull-to-Energy system.

"Smith Foundry is committed to providing a safe and healthy workplace for its employees, to improving the environment in the Phillips Neighborhood, and to being a good corporate citizen. For decades our long-term goal has been to develop pollution prevention initiatives that will allow us meet or exceed current city, state, and federal environmental standards. We recently entered into 2 year environmental improvement study with MnTAP. With the assistance of Al Muntasar Al Busaidy, we are developing a program to find environmentally friendly products for our production of castings, to become more energy efficient, and reduce our carbon footprint. With this project, we are confident that we will be able to achieve our pollution reduction goals."

~ Steve Coozennoy, Smith Foundry

Incentives for Change

Smith Foundry Company feels committed to the community and aims to improve air quality by reducing air contaminates, including particulates, VOCs and HAPs. In addition, a recent change to OSHA silica regulations cut the current standard by 50%: a difficult challenge for most foundries, since silica sand is a main ingredient in making green sand and cores. This project will reduce operators' health risk and make the working environment safer. Finally, they want to increase their profits by reducing operating costs and reducing waste.

Solutions

Switch to Alternative Binders

Smith Foundry uses industry standard chemical binders to cure and harden silica sand in the core making process, which do emit a certain amount of VOCs, HAPs, CO, and PM during the pouring, cooling, and shakeout phases of production. Switching to newer binder technology will allow the company to produce the same quality cores while reducing the environmental impact.

Implement Blackwater System

The Sonoperoxone Blackwater system applies advanced oxidants and hydroacoustic cavitation to spent green sand and baghouse dust. This enables the clay binder to be reused by restoring the binding effect of the clay. The water used in treating the sand or dust is then used to replace the fresh water currently used for the green sand molds, bringing with it the revitalized clay binder. The process reduces cost by decreasing clay, coal, and sand consumption, while also diminishing air pollution from VOCs and HAPs. Research at 50 iron casting foundries using the system indicates that they use 27-60% less clay and coal, 20-37% less silica sand and produces 19-70% less VOCs during pouring, cooling and shakeout. Further investigation is needed before implementation at Smith Foundry, but these results indicate potential savings of $30,000 to $60,000 per year, with reductions of 65 to 140 tons in clay and coal and 250 to 460 tons in silica sand.

Implement Mull-to-Energy System

Since the green sand temperatures and ingredients differ from batch to batch, mulling for a set amount of time, 90 seconds in the current case, could result in over or under mulling, which degrades molding properties. This results in inconsistent batch to batch mold quality, therefore; more defects and wastes. With the mull-to-energy system, two sensors track the horsepower of the muller motor. Once the energy added to the batch hits a plateau, the muller discharges the batch. Another benefit is speeding the discharging batches to all production streams if the mulling process does not need full 90 seconds, resulting in increased throughput for the entire production process.

Optimize Pipe Design

The amount of silica sand bought annually is 1248 tons, which costs $46,000. When conveyed with high pressure through 90-degree elbows it degrades and fractures. About 2%, or 25 tons, of the conveyed silica sand breaks into inhalable particulates. The breakage of the sand increases the amount of dust that needs to be captured by dust collectors and eventually goes to a landfill. Therefore, optimizing the pipe design to allow conveying the new silica sand with lower pressure could decrease the degradation of sand, prolonging sand life and reducing silica exposure in the foundry.

Switch from Pneumatic to Electric Tools

Finishing off castings, by removing the extra pieces of material, is heavily dependent on pneumatic grinding tools. Pneumatic tools run on compressed air and are much less efficient than electric tools.

Recommendation	Annual Reduction	Annual Savings	Status
Switch to alternative binders	49 lb. VOCs, 74 lb. CO, 11 lb. HAPs, and 47 lb PM	$900	Recommended
Install blackwater system	60 tons clay, 250 tons silica sand, and 19% VOCs during pouring, cooling, and shakeout	$30,000	Under review
Install mull-to-energy system	120,000 kWh	$8,400	Recommended
Optimizing piping design for new silica sand	25 tons silica sand	$3,600	Testing
Switch from pneumatic to electric tools	171,000 kWh	$17,200	Under review

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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 addtion to the intern program include site visits, team facilitation and phone assistance.

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