MnTAP

SOLUTIONS

2024 MnTAP Intern Program

MINNESOTA POLLUTION CONTROL AGENCY

CELEBRATING 40 YEARS MnTAP Pollution Prevention

"The internship provided me with many benefits, as my engineering skills have been immensly refined. I was able to get an inside look into how engineers look at and solve problems in the field. Additionally, I gained significant experience in the field of environmental sustainablility."

~ Gannon Shilson, Mechanical Engineering, University of Minnesota Twin Cities

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Intern Projects

Project Focus Key

Chemicals | Electricity/ Natural Gas | Water | Waste | Greenhouse Gas Emissions

MnTAP thanks our generous partners who make this vital work possible. Each of these organizations contributed financially to the intern program in 2024. Their support helps maintain our continuing pollution prevention, energy efficiency and water conservation work.

METROPOLITAN COUNCIL

"Several areas of the metro region are facing major water supply challenges to meet their current and projected water demands. MnTAP, through its internship program, is working effectively to identify and implement significant water saving improvements at industries to help preserve the region's critical water resources while saving costs for the industries and their customers. MnTAP's efforts to optimize use of resources, improve public health and the environment, and reduce energy use and costs have aligned with the goals and objectives of the Metropolitan Council. As a result, Metropolitan Council's partnership with MnTAP has been successful and beneficial to the entire metro region."

~ Greg Johnson, PE, Principal Engineer, Water Resources Planning, Metropolitan Council

Xcel Energy® RESPONSIBLE BY NATURE®

"Xcel Energy values our partnership with MnTAP for the fresh perspectives and innovative ideas interns bring to our customers' facilities. Their studies help implement energy-saving projects and provide clear paths to our rebate programs. This collaboration supports our mission to reduce carbon emissions and inspires future industry professionals."

~ Ashley Haung, Associate Product Portfolio Manager, Xcel Energy

MINNESOTA POLLUTION CONTROL AGENCY

"The 14 projects that were part of this year's intern program identified an impressive array of pollution prevention opportunities at sites ranging from food manufacturers to correctional facilities. I especially enjoyed the Niron Magnetics project, where the intern identified a safer solvent alternative for their manufacturing process of clean earth magnets, a safer alternative to those made of rare earth metals. I strongly recommend contacting MnTAP to see how your organization can benefit from this outstanding program!"

~ Mark Snyder, Pollution Prevention Coordinator Minnesota Pollution Control Agency

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Funding for three 2024 MnTAP Intern projects was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources.

"The LCCMR is proud to have supported the MnTAP internship program, which helps train the next generation of Minnesota's workforce in environmental stewardship while providing Minnesota businesses with valuable technical expertise. This program exemplifies the benefit of the Environment and Natural Resource Trust Fund to Minnesota's environmental and economic health."

~ Legislative-Citizen Commission on Minnesota Resources

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

"MnTAP and the leadership it provides under its internship program to develop our next generation of sustainability leaders have been critical in supporting EPA's Pollution Prevention program. We have benefitted greatly from the contributions of MnTAP interns through their technical assistance visits in helping small businesses and manufacturers become greener by tackling the source of pollutants. Not only are interns learning how to identify pollutant sources for reduction opportunities and track and measure these results, but they are also learning the value in documenting best practices and lessons learned along the way, which are equally important in shaping our next generation of environmental leaders."

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

2024 Intern-Proposed Solutions

Recommendation	Reduction	Cost Savings	Equivalents
Water Conservation	206,500,000 gallons	$690,000	Water for more than 9,000 Minnesota residents
Electricity	7,700,000 kWh	$379,000	Electricity for 800 Minnesota homes
Gas	553,000 therms	$266,000	CO_2 emissions from 620 passenger vehicles
Waste Reduction (Solid, Hazardous, Air Emissions)	3,980,000 lbs	$1,150,000	Annual waste from 2,000 Minnesota residents
Total Potential Cost Savings	---	**$2,485,000**	---

All table values for Reduction, Cost Savings and Equivalents refer to annual impacts.

Be Part of the 2025 Intern Program

Students:

- Gain hands-on project management experience.
- Use classroom knowledge in a real-world setting, applying your own creativity.
- Learn from host-site and MnTAP staff mentors.
- Make a difference by reducing resource consumption and improving business processes.
- Earn $19.00/hour working 40 hours a week during a three-month project.
- Receive a $1,500 stipend upon successful completion of the project.

Student applications accepted December 2024 through March 2025.

Learn more and apply at:
http://www.mntap.umn.edu/interns/student/

Businesses:

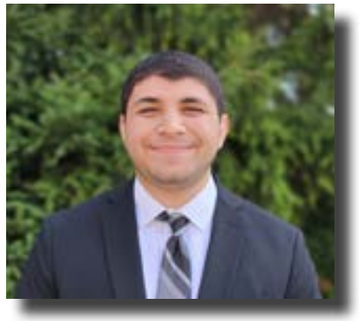
- Work with MnTAP engineers and scientists to scope and tailor a project to your needs.
- Discover process improvement opportunities that impact waste, water and energy efficiency.
- Receive co-supervisory support from a MnTAP engineer or scientist throughout the summer.
- Reduce resource use and cut costs.
- Pay just $4,000 for the 3-month project including follow-up assistance from MnTAP staff.

Applications accepted November 2024 through January 17th 2025.

Learn more and apply at:
http://www.mntap.umn.edu/interns/business/howtoapply/

For any questions and general information on the MnTAP Intern Program, contact Intern Program Manager Matt Domski at 612-624-5119, mdomski@umn.edu or http://www.mntap.umn.edu/interns/

AaCron, Inc.



Osama Samaha
Chemical Engineering
University of Minnesota Duluth

Organization Background

AaCron Anodizing is in Plymouth, Minnesota and began their operations in 1968 as a single process line specializing in aluminum window casings and sheets. By 1975, a second process line was established, and the facility expanded to 70,000 square feet. They currently have a team of 78 employees and take pride in their portfolio of unique finishes, colors, and large projects.

"My time at AaCron Anodizing gave me a once in a lifetime experience in industry and exposed me to the art of anodizing. I enjoyed being a part of a team that was supportive and committed to my work. I appreciate MnTAP for giving me the opportunity to develop my skills as a young engineer and will look back at my time at AaCron proudly." ~Osama Samaha

Project Background

Anodizing is a metal finishing process that uses a combination of water, electricity, and chemistry to produce an array of finishes and colors. Prior to the project, the facility recognized there were opportunities to reduce their water and energy use. Therefore, this project focused on optimizing the schedule for well operation, exploring how to reduce the flow rates for 15 rinse tanks, and improving efficiency of the natural gas fired dryer.

Incentives to Change

AaCron's water is supplied by three onsite wells. Process water is discharged to a sanitary sewer, while non-contact cooling water is permitted for discharge to an onsite pond. Although there are low costs associated with their water use and discharge, they were interested in exploring new water conservation and resource efficiency opportunities at their facility to demonstrate their commitment to environmental stewardship.

> *"It is clear that MnTAP takes time and care to match each intern with their respective company. Osama's work ethic and enthusiasm was apparent from day one. He fit in and operated not just as an intern, but as a member of the team. While his innovative ideas will be missed, his work this summer is integral to meeting our environmental sustainability goals."*
>
> *~Casey Selle Charging, Technical Manager, AaCron Anodizing*

SOLUTIONS

Install Continuous Flow Pipe Restrictors

Prior to the project, AaCron used 8.5 million gallons of water in their 15 rinse tanks with each operating at a flow rate of 2 gallons per minute (gpm). To reduce rinse tanks' water use, the site installed pipe restrictors. These reduced the flow by nearly 70% without impacting the rinse process. Overall, this suggestion will save AaCron over 6.6 million gallons and $33,000 per year. It already has a shorter than expected payback period, which was initially projected to be two weeks.

Enforce Restricted Well Usage

At the beginning of the project, AaCron's wells were manually activated at 4:00 AM even though the process line did not begin until 5:00 AM. This presented an opportunity to save water that was not being used for its operations. After coordinating with the operators, a later activation time of 5:15 AM was established. This change was enforced through a new procedure and log sheet to ensure the change would be followed. This change will save 9.8 million gallons and $3,200 per year.

Solutions

Fix Compressed Air Leaks

Compressed air is used throughout AaCron but mainly on the process lines and in the tooling shop. The air hoses are often used and tugged on, which can lead to imperceptible air leaks around the fittings. An ultrasonic leak detector was used to check for leaks and helped find 12 leaks around the facility. Once the compressed air leaks are fixed, it will save 24,700 kilowatt-hours (kWh) and $3,400 per year. These fixes will cost a total of $130 to correct and will result in a payback period of 2 weeks.

Install Kill Switch Timer for Dryer

AaCron has one natural gas-powered dryer, which is used to dry off parts at the end of the process line. This dryer uses an on-off switch and commonly runs even after the parts have been removed. To reduce excess use of the dryer, it was recommended to install a kill switch timer, which would enable operators to set a specific duration for the dryer operation. This switch is estimated to save AaCron 3,000 therms and $1,400 dollars per year. The switch has an estimated cost of $900, which results in a payback period of 8 months.

Install Air Cooled Chiller for South Well Single Pass Cooling

AaCron uses nearly 150 million gallons of well water per year for non-contact, single-pass cooling. This includes 78 million gallons from the North well and 70 million gallons from the South well. By installing an air-cooled chiller along the South well water-cooling line to remove excess heat, AaCron would no longer need to use the North well and could save 78 million gallons per year. Due to the low costs associated with well water, this would only result in savings of $16,000 per year. With an implementation cost of $600,000, the payback period would be approximately 36 years. Due to this long payback period, this recommendation requires further investigation. However, AaCron is committed to researching avenues for water reduction with non-contact water and will seriously consider this recommendation.

Install Lid for Dryer

AaCron's dryer does not have a lid. Therefore, as heat is generated by the natural gas flame, it rises and escapes from the dryer's walls. This results in heat loss and decreases drying efficiency. The installation of a lid is estimated to save 10,500 therms and $5,000 per year. Other benefits include shortened production times for each load and an increased lifespan of the burner due to reduced usage. A lid is calculated to cost $9,000 with a payback period of 2 years. With limited space around the dryer for lid placement, this implementation requires further investigation.

Recommendation	Annual Reduction	Annual Savings	Status
Install Continuous Flow Pipe Restrictors	6,600,000 gal water	$33,000	Implemented
Enforce Restricted Well Usage	9,800,000 gal water	$3,200	Implemented
Fix Compressed Air Leaks	24,700 kWh	$3,400	Planned
Install Kill Switch Timer for Dryer	3,000 therms	$1,400	Recommended
Install Air Cooled Chillers for South Well Single Pass Cooling	78,000,000 gal water	$16,000	Further Investigation Needed
Install Lid for Dryer	10,500 therms	$5,000	Further Investigation Needed

MnTAP Advisor: Kelsey Klucas, Director

Aspire Bakeries

Jackson Harris
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

Aspire Bakeries comprises 14 locations across the United States and Canada. It produces 900 million pounds of baked goods per year and is dedicated to creating the highest quality, best tasting baked goods on the market. The Chaska facility, the site of the internship project, manufactures 164 variations of frozen Otis Spunkmeyer cookie dough and around 50 million pounds of cookie dough per year. It measures 108,500 square feet and employs 114 people.

"Working at Aspire Bakeries through MnTAP this summer was an amazing experience! This project was a perfect introduction to working in a manufacturing environment as well as on sustainability efforts. My project management and communication skills have improved exponentially this summer and I feel like I have grown a ton through my work." ~ JH

Project Background

At the Chaska facility, 6.6 million gallons of water and 7.3 million kilowatt-hours (kWh) are currently used each year. The ammonia refrigeration system consumes considerable water and electricity, and the compressors are the number one consumer of energy at the facility. This project focused on the ammonia refrigeration system with compressor energy use and condenser water use receiving added attention. The sanitation process and compressed air system were also evaluated for potential resource saving opportunities.

Incentives to Change

One of the company's main goals is to reduce scope 1 and 2 emissions by 46% by 2030 compared to a 2019 baseline. In Chaska, there are many opportunities to cut costs and resource use, especially since the facility has been using more water due to enlarging and more varied production.

The passion Jackson showed in identifying opportunities, collecting data and translating it into actionable improvements was outstanding. I look forward to working with MnTAP in the future to continue to educate the next generation of leaders."

~Peter Boevers,
Operational Excellence Manager

SOLUTIONS

Use Low Flow Nozzle Tips for Sanitation

The hoses for sanitation come with a standard flow rate tip and a low flow rate tip. Currently, the facility uses the standard flow rate tip. However, if they switched to the low flow rate tip, they would use around 25% less water. This could reduce as much as 780,000 gallons per year. Since the facility already owns these tips, the implementation cost would be $0 for $7,400 in yearly savings.

Replace Line 3 Vortex Panel Cooler with Air-to-Air Heat Exchanger

The facility currently uses two compressed air vortex panel coolers. Vortex panel coolers work by first separating input compressed air into a hot and cold stream with a vortex. Then, the cold stream is used to cool the panel, and the hot air is discharged. Switching the larger Line 3 panel to an air-to-air heat exchanger would save 17,700 kWh and $1,600 annually. The cooling capacity provided by an air-to-air heat exchanger would be excessive for the other panel, so installing a solenoid valve controlled by panel temperature to limit the amount of compressed air used is recommended. The savings and associated costs of solenoid valve and temperature control are unknown but would also reduce panel cooling energy use.

Solutions

Increase Cycles of Concentration to 3.8 and Update Condenser Water Treatment

Increasing the cycles of concentration from 1.6 to 3.8 and updating the current water treatment plan is recommended. Increasing the cycles of concentration raises the alkalinity of the water to protect against further corrosion and scaling that are preventing the condensers from running at peak efficiency. For the two 18 to 20-year-old condensers, heat transfer efficiency is reduced significantly due to corrosion and scaling. Since the new one-year-old condenser is already showing scaling and corrosion, this condenser will likely degrade quickly with the current water treatment regimen. Updating the water treatment plan will extend the lifespan of the old condensers and protect the new condenser from corrosion and scaling. The total cost and savings for new water treatment have yet to be determined, but the increase in cycles of concentration would save 1,400,000 gallons and $13,400 per year.

Enable Floating Head Pressure Control for Ammonia Compressors

This action varies the ammonia temperature depending on the outside wet bulb temperature. This saves energy by reducing the compressor discharge pressure. In the winter, the lower wet bulb temperature allows the compressors to run at a lower discharge pressure and save energy compared to the higher set points for summer wet bulb temperatures. The control ensures that the temperature difference between the ammonia and outside air stays constant throughout the year, which ensures that effective ammonia condensation occurs. The facility already has this control in place, but it is currently disabled. Enabling the floating head pressure control could save 400,000 kWh per year and $36,200 in associated electricity costs. Additional testing is needed to ensure that this reduction could be achieved with the current condensers, but any reduction in discharge pressure would save energy.

Recommendation	Annual Reduction	Annual Savings	Status
Use Low Flow Nozzle Tips for Sanitation	780,000 gal water	$7,400	Recommended
Replace Line 3 Vortex Panel Cooler with Air-to-Air Heat Exchanger	17,700 kWh	$1,600	Recommended
Increase Cycles of Concentration to 3.8 and Update Condenser Water Treatment	1,400,000 gal water	$13,400	Recommended
Enable Floating Head Pressure Control for Ammonia Compressors	400,000 kWh	$36,200	Recommended

MnTAP Advisor: Laura Sevcik, Engineer

Donaldson Company

Daniel Rudolph
Sustainable Systems Management
University of Minnesota Twin Cities

Organization Background

Donaldson Company, Inc. is a vertically integrated filtration company specializing in producing and marketing air filters across multiple industry sectors. Founded in 1915 and headquartered in Bloomington, Minnesota, the company's product portfolio includes filters for applications in agriculture; construction; transportation; manufacturing; and controlling the contamination of dust, fumes, and mists. Donaldson's research and development (R&D) headquarters plays a critical role in advancing filtration technologies and enhancing product performance.

"The opportunity to have my summer internship with MnTAP bolstered my techical skills from initial research to publication. I am very grateful to be given the chance to directly apply my skills in sustainability to improve an real industrial system." ~ DR

Project Background

This project focused on foot printing and optimizing the Liquid Lab's chilled water processes. It included helping Donaldson better understand its current cooling loads, cooling capacities, and energy opportunities associated with the chilled water system. In Fiscal Year 2023, the company contemplated installing a new chiller to enhance performance. This could provide additional cooling capacity to the Liquid Lab, avoid the costs associated with purchasing an oversized chiller, and present an opportunity to assess whether the current Chilled Water (CHW) system could be optimized to meet the lab's needs more efficiently. By deepening our understanding and improving the existing cooling infrastructure's efficiency, this project would support Donaldson's broader sustainability objectives while ensuring operational effectiveness.

Incentives To Change

Donaldson Company is committed to sustainability, as outlined in their Fiscal Year 2023 (FY23) Sustainability Report. This project directly contributes to their 2030 Environmental and Social Ambitions, which aligns with global efforts to mitigate climate change. Donaldson is focused on reducing its energy consumption and expanding its clean energy portfolio. They are aiming at a 42% absolute reduction in Scope 1 and 2 greenhouse gas (GHG) emissions by fiscal year 2030 and in line with the Intergovernmental Panel on Climate Change (IPCC) 1.5°C global warming scenario. This initiative not only supports regulatory compliance and enhances environmental stewardship but also addresses the economic impacts of energy costs, raw material use, and waste management.

"Daniel's work was a great example of how small changes can drive significant impact. He focused on improving the performance of the chiller system in our Liquid Lab, demonstrating through careful data collection that we could increase efficiency without any additional cost. His findings gave us the confidence to implement changes that will improve the performance of our test benches while also identifying quantifiable opportunities for energy savings."

~ Hans Wucherpfennig
Donaldson Company, Inc.

Solutions

Improve Utilization of Current Chiller

In the short term, optimizing the use of the current chilled water chiller and addressing any maintenance needs it has would help its operational efficiency. This avoids the one-time project cost estimated between $250,000 and $300,000. Conversely, the chiller is older than 40 years and there are legitimate reliability concerns, so replacing it with the same refrigeration tonnage of 20 tons or less should be considered given its current heat load. Replacing the chiller would align with both the long-term goal of maintaining operational efficiency and would ensure the chiller's continued reliability.

Reduce Chiller Water Pump Impeller Diameter

Reducing the impeller diameter of the basement chiller pump could reduce up to 4,500 kilowatt-hours (kWh) annually and result in a potential savings of approximately $450.

Reduce Lab-Side Pump Flowrate by 20%

We recommend reducing the flow rate of the lab-side pump by 20%. The implementation of this adjustment is immediate and would make it a practical and cost-effective solution for optimizing the system's energy consumption. Implementing this could result in an annual reduction of 10,000 kWh and result in a potential savings of $1,000.

Remove Heat Exchanger

There is a water-to-water heat exchanger which exchanges heat between the lab process cooling loop and the chiller cooling loop. Because both loops contain water and using a heat exchanger would incur an efficiency loss, the calculation was completed for the energy and cost savings behind removing this heat exchanger. The team later learned that the loops were separated to prevent safety concerns from any cross contamination between the lab process and the general cooling loop, so this opportunity is not planned for implementation.

Recommendation	Annual Reduction	Annual Savings	Status
Improve Utilization of Current Chiller	To be determined	$0	Recommended
Reduce Chiller Water Pump Impeller Diameter	4,500 kWh	$450	Investigating
Reduce Lab-Side Pump Flowrate by 20%	10,000 kWh	$1,000	Recommended
Remove Heat Exchanger	3,222 - 22,284 kWh	$322 - 2,284	Not Planned

MnTAP Advisor: Jon Vanyo, Senior Engineer

Donaldson Company

Sanat Iyer
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

Donaldson Company, Inc. was founded in 1915 by Frank Donaldson Sr. to sell air filters for tractors. The company grew and specialized in engine and industrial filtration systems for many different business sectors. In 1962, Donaldson moved its headquarters to Bloomington Minnesota, and it continues to employ 1,250 people in Minnesota. The company has also grown internationally with 12,500 employees and 140 facilities located across 44 nations around the world.

My summer internship with MnTAP and Donaldson was an excellent opportunity. With guidance from professionals in the field with industry experience, I was able to learn a lot about manufacturing and gain real-life engineering skills. I am very grateful to the MnTAP staff and to all members of Donaldson who helped contribute to a positive internship experience." ~ SI

Project Background

Donaldson performs testing on air oil filters that remove oil from compressed air. This takes place in the compressed air lab, which has several compressors operating according to testing requirements at the time. Testing on these filters requires the compressors to always operate at maximum loading, as the pressure of the air must remain constant to meet the International Organization for Standardization (ISO) testing standards.

Once testing is complete, the compressed air is currently being vented into the atmosphere. The project team was interested in exploring whether some of this air, or its associated energy value, could be harnessed for reuse. This project seeks to identify options to recapture or reuse this air to save energy and reduce costs at Donaldson

Incentives To Change

Donaldson has 2030 Environmental and Social Ambitions, including a goal of 42% carbon reduction in alignment with science-based targets from the Intergovernmental Panel on Climate Change. The compressed air lab uses 950,000 kWh (kilowatt-hours) per year in energy. This is a substantial source of compressed air energy, which could be harvested for energy generation or reused to help Donaldson reach its carbon reduction goals.

SOLUTIONS

Link the Lab and House Compressors

The lab compressed air that is currently being vented could instead be connected to the main house compressor lines to feed the main house compressed air. To achieve this, pressure downstream of testing should be regulated to ensure the test compressors never turn off. Installing a pressure regulator or digital valve between the test lines and the house lines could ensure the test compressors experience a consistent pressure drop to maintain dependable test conditions.

This project tried maintaining the system pressure with a large pressure relief valve, but that valve's pressure control capabilities were not accurate enough for this purpose. Instead, Donaldson should further explore a digital valve or pressure regulator valve to allow for this venting and to connect the house and lab compressed air systems. The maximum achievable energy savings for this suggestion is 484,000 kWh per year with an annual cost savings of $48,400. On top of this, connecting the compressed air systems may deter the purchase of new house air compressors, which would lead to additional savings.

Solutions

Install an Energy Recovery System

An alternative to reusing the lab compressed air is to install an energy recovery system with a gas turbine and a generator to convert the compressed air back into energy. The gas turbine would be added at the exhaust of the vented air, and the generator would connect to the main power grid. This would allow for energy to be recovered from the vented air while also ensuring that the filter testing is uninterrupted. The potential savings for this solution is 570,000 kWh per year or an annual cost savings of $57,000. This solution also does not require new valve testing, as the air will still be consistently released downstream to maintain consistent test conditions.

Fix Air Leaks

It is recommended that Donaldson performs an air leak audit and fixes air leaks. After a brief air leak audit of certain sections of Donaldson's Bloomington campus, around 7,700 kWh or over $770 worth of leaks per year were found. Performing a deeper air leak audit to find and mark all the leaks throughout the Bloomington campus could yield additional savings for Donaldson.

"Sanat brought enthusiasm to his work at Donaldson, tackling an opportunity in our Compressor Lab. His project centered around finding a second use for the energy lost in compressed air, an often-overlooked but significant area of potential energy savings. By working closely with various stakeholders and navigating their concerns, Sanat was able to gather data, conduct tests, and build relationships within the company—all within the short span of the summer internship. His efforts resulted in a concept that we can now use to justify future implementation."

~ Hans Wucherpfennig
Donaldson Company, Inc.

Recommendation	Annual Reduction	Annual Savings	Status
Link the Lab and House Compressors	484,000 kWh	$48,400	Investigating
Install an Energy Recovery System	570,000 kWh	$57,000	Recommended
Fix Air Leaks (20% of facility assessed)	7,700 kWh	$770	Recommended

MnTAP Advisor: Jon Vanyo, Senior Engineer

FINNOVATION Lab

Jacob Bach-Dowd
Sustainable Systems Management
University of Minnesota Twin Cities

Organization Background

FINNOVATION LAB is based in Minneapolis and was founded in 2018 as a platform dedicated to supporting and accelerating the growth of social entrepreneurs. Their Circle Up Initiative is designed for upcycling companies to network and establish a thriving ecosystem for food waste in Minnesota. Food waste is a significant global issue as approximately 40% of all food produced never reaches consumers.
Upcycling converts food waste into shelf-stable ingredients that can be packed and reused in other food or beverages sold to consumers. Dehydration and fermentation are two common processes used in upcycling.

"I enjoyed learning about the processes behind food production and the challenges associated with upcycling. I was able to apply my skills by reducing food waste at an industrial scale and develop future opportunities for products using upcycled ingredients. Overall, this internship has prepared me to create meaningful and impactful change in my future endeavors." ~ JBD

Project Background

Upcycling has been gaining traction as a solution to reduce food waste and was introduced to the U.S. Environmental Protection Agency's Wasted Food Scale in 2023. This project was designed to address that tier of the food scale for Minnesota food clients. The project included outreach to various food manufacturers with byproduct waste streams and upcycling outlets, including a fermentation company and a dehydration client, with the goal of testing and matching current waste streams with compatible upcycling pathways. After creating an initial list of 25 to 30 opportunities, eight were selected for testing to see if they could produce viable byproducts by themselves or as ingredients for future products.

Incentives to Change

Upcycling has a variety of benefits including conserving valuable natural resources by reducing demand for raw materials; reducing costs associated with waste disposal, such as ending up in landfills; and promoting the development of new product lines, including those that appeal to environmentally conscious consumers. Raw materials can be costly or sensitive to price volatility whereas upcycled ingredients have more stable input costs. Sometimes byproducts can be processed into high-value ingredients, such as dietary fibers or protein powders, that can enhance existing products and lead to them being sold at higher price points.

Currently, the market availability of upcycled products is low due to lack of upcycled goods manufacturers. Projects like this demonstrate how improving relationships between food manufacturers and upcycled food manufacturers could streamline byproduct sourcing and encourage more businesses to consider incorporating upcycled ingredients into their products.

SOLUTIONS

This project identified more recommendations than could be covered in this executive summary. Please see the table for the full list of recommendations.

Upcycle Coffee Grounds into Edible Human Food Products

A local organic coffee producer generates roughly 40,000 pounds of spent coffee grounds per day. These grounds are of premium quality, and the manufacturer wanted to identify new opportunities to upcycle their coffee grounds to new products instead of their current practice of composting the grounds. Part of this test is dewatering the grounds, and successful batch tests showed dehydration worked well. MnTAP continues to work with this client closely on their dewatering needs so that the entirety of their grounds can be successfully upcycled into new human food products. If this recommendation was implemented, this could divert 3,510,000 pounds of spent coffee grounds into upcycled products per year.

Solutions

Upcycle Brewers Spent Grain into Pizza Dough

A byproduct of the brewing industry is Brewers Spent Grain (BSG), which consists primarily of barley grain husks that are leftover after extracting sugars for beer production. BSGs can become new ingredients for nutritious snacks and baking mixes, including creating specialty pizza dough. For this project, two breweries agreed to upcycle their BSG, which could be incorporated into pizza dough at the rate of four times per month. This could divert 36,000 pounds of BSG to upcycled products per year.

Ferment Fruit Juice Liquid Byproduct Monthly

Juicing companies regularly import 200-hundred-pound drums of juice, and around 20% to 60% of each drum can spoil before the company uses it. Over a year, this could add up to 156,000 pounds being discarded down the drain. This project identified an opportunity to connect this waste stream with a fermentation client with potential to produce fermented beverages, such as kombucha, cider, or fruit wines, by adding sugar and/or removing water.

Currently, this process is being implemented in a pilot phase. If successful, this recommendation could upcycle up to 600 pounds of juice into fermented products per year. This opportunity has also led to continued technical assistance, including an additional site visit to recycle or reuse the waste byproducts in the production process onsite.

"The program provided a strong set of solutions to the issue of food waste in Minnesota. The innovative advancements provided by MnTAP and the intern will be put to excellent use in the coming years as we work to reduce food waste in Minnesota. This is a difficult problem, and we wouldn't have made this much progress in a short period of time without the strong focus of this intern program. I look forward to supporting it in the future."

~ Jennifer Barta, FINNOVATION Lab CEO

Recommendation	Annual Reduction	Annual Savings	Status
Upcycle Coffee Grounds into Edible Human Food Products	3,510,000 lbs. waste	TBD	Testing
Upcycle Brewers Spent Grain (BSG) into Pizza Dough	36,000 lbs. waste	TBD	Testing
Ferment Fruit Juice Liquid Byproduct Monthly	600 lbs. waste	TBD	Recommended
Pilot Test Garbanzo Beans via Dehydration	750 lbs. waste for the pilot 93,000 lbs. waste at full scale	TBD	Recommended
Pilot Test 15 Different Feedstocks via Dehydration	11,250 lbs. waste	TBD	Recommended
Divert Oat Mash from Client to Community Kitchen for Baked Goods	9,000 lbs. waste	TBD	Testing
Find End Market for Dehydrated Distilled Spent Grains (DSG) from Client	9,000 lbs. waste	TBD	Find End Markets
Divert Eggshells to Toothpaste	1,000 lbs. waste	TBD	Testing
Continue Testing Vanilla Pods and Lavender via Fermentation	120 lbs. waste	TBD	Testing

MnTAP Advisor: Jon Schroeder, Waste Specialist

Lakeside Foods Solutions

Gannon Shilson
Mechanical Engineering
University of Minnesota Twin Cities

Organization Background

Lakeside Foods Inc. is a canned food and food product producer that was founded and remains headquartered in Wisconsin. At its Owatonna facility in Minnesota, it produces canned food products, such as dry beans, corn, peas, potatoes, mixed vegetables, and carrots. Currently, there are 123 full-time employees and an additional 180 seasonal employees.

"My summer internship with Lakeside Foods and MnTAP is an experience I will cherish for the rest of my career. The internship provided me with many benefits, as my engineering skills have been immensly refined. I was able to get an inside look into how engineers look at and solve problems in the field. Additionally, I gained significant experience in the field of environmental sustainablility. I'm thankful to MnTAP and Lakeside Foods for this incredible opportunity and I am now more excited to enter the field of environmental engineering! ~ GS

Project Background

At Lakeside Foods, water is by far the most used resource. Whether by means of washing the product, transporting the product, or cooking the product, water is used in almost every process. On average, the main facility in Owatonna uses over 130 million gallons of water annually. This water use costs the company almost $400,000 a year with an additional $650 monthly sewer charge. Additionally, reducing bean waste in their wastewater would lower levels of biochemical oxygen demand (BOD); chemical oxygen demand (COD); and total suspended solids (TSS) that can adversely impact downstream communities, wastewater treatment operations, and aquatic ecosystems.

Incentives To Change

Lakeside Foods takes pride in providing quality products while maintaining environmental sustainability. Hence, their incentives to participate include improving their ability to meet permits for irrigation, reducing water costs, enhancing their ability to operate more sustainably, and lowering contaminant concentrations in their wastewater.

SOLUTIONS

Hydro Sieve Replacement

Lakeside Foods uses a hydro sieve to separate water from the reject bean waste in the dry bean blanching process. Since the current hydro sieve is undersized for the reject stream's flow rate, water flows out of the recirculation system and into the drain. Replacing the current hydro sieve with an adequately sized hydro sieve would keep 1,270,000 gallons of water in the recirculation system and save $3,600 annually.

Bean Waste Diversion

Reject bean waste from the hydro sieve is sent directly into the drain, which eventually ends up in Lakeside Foods' wastewater treatment. Currently, Lakeside Foods uses water to move the beans through the drain and into the hauling truck. To divert the reject bean waste from the drain and wastewater treatment process, a cart can be placed at the end of the flume of the hydro sieve discharge. Lakeside Foods already owns these carts with perforated areas for drainage. Diversion of the bean waste would save 93,000 pounds of beans and $200 in polymer annually. Additionally, using these carts could potentially lead to bean waste upcycling as opposed to the beans being used for hog feed. Bean waste upcycling can provide a potential revenue stream.

Reduce Water Usage in the Can Cooler

Lakeside Foods uses a can cooling system that submerges cans in water. Currently, the cans are overcooled and well below the optimal temperature range. Reducing the flow rate of water into the cooling system would still allow the exiting cans to be within the optimal temperature range. By turning down the flow rate in the can cooler, Lakeside Foods could save 960,000 gallons of water and $2,700 annually.

Recirculate Blancher Discharge

Lakeside Foods uses two blanchers in sequence to blanch dry beans, and each blancher uses water to soak and cook the beans. Currently, the water is continuously discharged from each blancher and rich in starch. The dissolved air flotation (DAF) system treats the starch wastewater with a polymer as a coagulant. Instead of being discharged, each blanchers' water could be fed back into the blancher cooker through a recirculation system. Reducing the amount of starchy water sent through the water treatment system would decrease the strain on the DAF, and this could save $1,200 on polymer costs annually. Additionally, this solution would reduce 902,000 gallons of water annually, and therefore, save $2,600 annually.

Install 3 Float Valves in the Corn Room Wash Tubs

The three wash tubs in the corn room are currently filled with water and stopped at the operator's discretion. Water tends to overflow out of the tubs and into the drain. Overflow can be prevented with the addition of float valves. The annual reduction and savings are yet to be determined and would need further analysis.

"It was a pleasure having Gannon doing his internship here at Lakeside Foods. Gannon did a great job locating areas to improve. We are looking to implement some of Gannon's findings after our pack season ends. Working with MnTAP, Kevin, and Gannon has been rewarding for Lakeside Foods."

~ Mark Breon, Operations Manager, Lakeside Foods

Recommendation	Annual Reduction	Annual Savings	Status
Hydro Sieve Replacement	1,270,000 gal water	$3,600	Recommended
Bean Waste Diversion	93,000 lbs. beans	$200	Recommended
Reduce Water Usage in the Can Cooler	960,000 gal water	$2,700	Recommended
Recirculate Blancher Discharge	902,000 gal water	$3,800	Needs Further Analysis
Install Float Valves (3) in Corn Room Wash Tubs	To Be Determined	To Be Determined	Needs Further Analysis

MnTAP Advisor: Kevin Philpy, Senior Engineer

Liberty Paper

Jannatul Adnin Eshita
Chemical Engineering
University of Minnesota Duluth

Organization Background

Liberty Paper Inc. is a 100% recycled liner paper manufacturing mill that is owned by Liberty Diversified International and located in Becker, Minnesota. It is one of the largest recyclers of corrugated containerboard in the Midwest. Each year, the mill diverts approximately 275,000 tons of corrugated containerboard from landfills, or the equivalent of saving approximately 3,000 acres of trees. It processes this material to produce 255,000 tons of recycled linerboard annually.

"Working at Liberty Paper was one of the best times in my life. The liberty Paper staff were not only supportive but also valued my input, quickly making me an integral part of the team. Throughout this internship, I had the opportunity to apply my engineering knowledge in a real-world setting." ~ JAE

Project Background

Paper mills, such as Liberty Paper, consume on average 1,000 gallons of water per ton of paper, which is a significant amount of fresh water in their manufacturing processes. Liberty Paper uses fresh water for formulating chemicals, non-contact cooling, tank makeup, pump sealing, and other purposes. Notably, 80% of this fresh water is reused within the paper machine shower system and for chemical dilution, while the remaining 20% is used for single-purpose applications. The goal of this project is to reduce freshwater consumption, thereby decreasing wastewater discharges. To achieve this, the project focuses on mapping the freshwater supply systems, measuring consumption, exploring opportunities for freshwater reduction and process water reuse, and minimizing wastewater discharges.

Incentives To Change

As a 100% recycled paper mill, Liberty Paper is committed to advocating for sustainability and improving the environment. The company continuously seeks opportunities to reduce freshwater usage. Over the years, Liberty Paper has successfully explored various areas to reduce freshwater consumption. However, recent expansions have led to an increase in annual consumption. Through this project, Liberty Paper aims to achieve its Environmental, Social and Governance (ESG) water efficiency targets while also achieving cost savings through reduced freshwater processing and wastewater discharge.

Solutions

Reuse Cooling Tower Blowdown Water for Coagulant Mixing

Fresh, softened water is used to formulate coagulant in the wastewater treatment system. By redirecting the continuous flow of purged water from the outlet of the cooling tower to the chemical mixing point, this change will save 1 million gallons of fresh water annually and result in an annual cost savings of $4,000.

Reuse Couch Vacuum Pump Seal Water for Cooling

Currently, the couch agitator uses fresh water directly from the distribution header. The purged seal water from the couch separator vacuum pump remains cold enough to reuse as a couch agitator coolant. The proposed system change needs a storage tank, an inline filter, and a pump. Reusing the seal water from the couch separator vacuum pump will save 200,000 gallons of freshwater and result in an annual cost savings of $800.

Reuse Seal Water as Filter Shower

The vacuum system seal water recirculation loop has a filter to remove contaminants from the seal water. The filter surface is cleaned using warm soft water in high-pressure, rotating showers. Excess clean seal water from the recirculation loop will be reused in the shower system instead. A booster pump will be installed to direct this seal water to the filter's shower bar. This change will save 10 million gallons of fresh water annually and result in annual cost savings of $40,000.

Optimize Mill Heat Exchanger

Cold fresh water is used in the mill plate heat exchanger to remove heat from the steam condensate and heat water for applications that have specific temperature requirements. The minimum flow rate of fresh water required to achieve the appropriate temperatures of warm water and condensate exceeds the quantity needed for downstream processes because the heat exchanger has too much heat transfer capacity. Optimization of the mill heat exchanger, either by reducing the number of plates in the current stack or by replacing it with a properly sized unit, would allow the freshwater flow to be reduced while achieving the necessary fluid temperatures. This option would save 38 million gallons of fresh water annually and result in cost savings of $146,000 per year.

"Our company has been mapping out our sustainability goals, and Janna's recommendations will help us reduce fresh water usage in our manufacturing process. I would highly recommend other companies who are looking for ways to save on water and energy to look into MnTAP"

~Thomas Murphy
Senior Manager Technical Services
Liberty Paper, Inc.

Recommendation	Annual Reduction	Annual Savings	Status
Reuse Cooling Tower Blowdown Water for Coagulant Mixing	1 million gal water	$4,000	Implementing
Reuse Couch Vacuum Pump Seal Water for Cooling	200,000 gal water	$800	Recommended
Reuse Seal Water as Filter Shower	10 million gal water	$40,000	Implementing
Optimize Mill Heat Exchanger	38 million gal water	$146,000	Implementing

MnTAP Advisor: Jane Paulson, Senior Engineer

Michael Foods

Padon Kinzley
Bioproducts & Biosystems Engineering
University of Minnesota Twin Cities

Organization Background

Michael Foods, a subsidiary of Post Holdings, is a large producer of value-added eggs and refrigerated potatoes. The company was founded in 1987 as a spin-off from North Star Universal Inc. and has grown into a leader in the processed food industry. Michael Foods has 17 plants, 9 farms, and over 4300 employees throughout 11 states. This project focused on Michael Foods' potato processing plant in Chaska, Minnesota. Annually, the plant with 369 employees produces 259,000,000 pounds of potato products, including hash browns, mashed and diced potatoes.

"I was able to get first hand experience in the industrial sector while making a positive impact on the environment and our state's public health. Over the summer I learned a lot about industrial food processing and the efforts that are made to optimize the use of our natural resources. I'm thankful for the support from MnTAP and Michael Foods and the opportunity to grow as an engineer." ~ PK

Project Background

As a company with a corporate responsibility for environmental sustainability, Michael Foods is constantly seeking to lessen its environmental impact. In 2010, Michael Foods closed its Minneapolis potato plant and opened a new one in Chaska. Three years later, a MnTAP intern investigated water conservation opportunities at that plant. Much progress was made, but room for improvement remained. The new plant could primarily rely on well water until 2023 when the plant's water use led to low aquifer levels. This caused production to shut down regularly, and Michael Foods decided to purchase water from the Met Council. While this change led to fewer production shut downs, expenses increased due to the higher cost of Met Council water.

Incentives To Change

Since the 2013 internship, production has increased by 22%, and water use has surged by 32%. Recently, the plant's water demand surpassed what can be drawn from its own well, and it now depends on the Met Council for its water supply. Given how expensive this water source is, Michael Foods is incentivized to reduce the amount of water its plant consumes for daily operations and lower its utility costs.

SOLUTIONS

Install Flow Restrictors on Peel Starch Separators

There are three peel starch separators on the peel floor in the Shred, Dice, and Retail Mash lines. These large rotating drums remove any excess peels after the potatoes go through the steam peeler. They require water to flush the removed peels from the machine, so it is possible to use more water than needed. According to the manufacturer, each rotating drum requires 5 gallons per minute (GPM). They currently run at over 10 GPM. Therefore, 5 GPM flow restrictors, which constrict the area where water can flow, should be installed on pipes for each of the three peel starch separators. This ensures that the correct amount of water is used and would save approximately 4,700,000 gallons of water and $49,000 annually.

"Padon came to work with a great attitude and work ethic to find ways to reduce our water usage. Padon discovered several areas where we could reduce usage if the correct equipment is installed, and I look forward to putting some of these ideas to use."

~ Klel Harris, Michael Foods

Solutions

Install Flow Restrictor on Washer Sprayers

Immediately after entering the plant, potatoes are sent through a large washer to remove dirt and sand. The potatoes are then hit with five sprayers flowing at 16.5 GPM to remove any excess debris. As the sprayer water returns to the washer and causes its water level to rise, a stream of water flowing at 15.5 GPM from the washer's bottom helps prevent overflow. Dirty excess water then falls directly onto the floor drain, and more water is ultimately needed to clean the area. Using a flow restrictor on sprayers could resolve this issue, and testing revealed that a spray rate of 5 GPM would still adequately clean potatoes. Installing a 5 GPM flow would save approximately 3,600,000 gallons and $38,000 annually.

Automate Raw Receiving Conveyor and Sprayer Shut-Off

Around every 40 minutes, a truckload of potatoes falls onto conveyor belts at the Raw and Receiving area, and the potatoes typically spend around 26 minutes on the moving belt. The sprayers after the washer are also simultaneously running. Since the programmatic logic control runs the conveyor system, it would be possilbe to automatically shut down the conveyors when no potatoes are coming into the plant to lower energy costs. If the recommended 5 GPM flow restrictor is installed, this will save 520,000 gallons and $5,000 annually.

Install Actuators in the Food Service Mash Line

The conveyor system in the Food Service (FS) Mash line is run automatically using a programmable logic control. Whenever the conveyor stops, the flow of water to each piece of machinery must be shut off manually. Installing actuators on this line could automate the water shut-off process and save approximately 180,000 gallons of water and $2,000 per year. Additional study may be needed to quantify the exact savings.

Install Nozzle on USDA Hose

Before going into the washer, some potatoes are taken to a United States Department of Agriculture (USDA) station for quality assurance tests. One test requires a bucket full of water, and this bucket is kept clean by being continually emptied and refilled. Staff currently use an open hose to refill this bucket, which requires staff to walk around 20 feet before they can turn off its valve. Although the hose is left on a fraction of the time, the flow rate can be as high as 18 GPM. Attaching a manually controlled nozzle to the hose would help staff more promptly turn off the nozzle, and this action could save save up to 75,000 gallons and $800 annually.

Insulate Steam Pipes

Steam is used in many processes throughout the plant and requires a great deal of energy to create. Insulating steam pipes would reduce the amount of thermal energy released into the surroundings. Currently, the steam pipes' insulation is beginning to degrade or fall off entirely due to the steam's high heat. While replacing the insulation is not urgent, the energy costs are expected to rise every year. Replacing the insulation in the next couple of years could save 54,000 kilowatt-hours (kWh) and $6,500 annually.

Recommendation	Annual Reduction	Annual Savings	Status
Install Flow Restrictors on Peel Starch Separators	4,700,000 gal water	$49,000	Recommended
Install Flow Restrictor on Washer Sprayers	3,600,000 gal water	$38,000	Recommended
Automate Raw Receiving Conveyor and Sprayer Shut Off	520,000 gal water	$5,000	Recommended
Install Actuators in the Food Service Mash Line	180,000 gal water	$2,000	Recommended
Install Nozzle on USDA Hose	75,000 gal water	$800	Recommended
Insulate Steam Pipes	54,000 kWh	$6,500	Recommended

MnTAP Advisor: Kevin Philpy, Senior Engineer

MN Dept. of Admin, Office of Enterprise Sustainability

Lucy Weglarz
Bioproducts & Biosystems Engineering
University of Minnesota Twin Cities

Organization Background

The State of Minnesota formed the Office of Enterprise Sustainability (OES) in 2017 under the Department of Administration to assist state agencies in reaching state sustainability goals. It defines sustainability as meeting the economic, social, and environmental needs of the present without compromising the ability of future generations to meet their needs. OES helps agencies develop plans, identify funding opportunities, track progress, and report on accomplishments related to sustainability. The OES team is made up of five members.

"During my time working with the Office of Enterprise Sustainability, I had the opportunity to visit sites across Minnesota, work with colleagues across state agencies, and dive into the ins and outs of state government work. The OES team's passion for sustainability and commitment to enact meaningful change was incredibly inspiring to me. I am grateful for their support, as well as the support I received from MnTAP." ~LW

Project Background

The State of Minnesota comprises 23 cabinet agencies as well as the Metropolitan Council. Among these 24 organizations, there are 1,900 sites that host 3,900 buildings across the state. Overseeing so many buildings has been a barrier to making statewide changes to water use, especially with irrigation. The state's data collection program, B3 Benchmarking (B3), helped identify which agencies use more water, particularly in the summer. After further analysis, 12 sites were identified as having great potential to reduce water use based on current irrigation practices, estimated turfgrass area, and average rainfall data. Additionally, the 12 sites were chosen for their variety of locations, purposes, and anticipated needs.

Incentives To Change

OES is committed to helping state agencies reach statewide sustainability goals, including reducing building water use per square foot by 15% by 2030 compared to a 2017 adjusted baseline. Currently, the Minnesota State Government is 57% towards reaching its goal. State agencies are progressing at different rates towards this goal. Reducing water use can be challenging for agencies with many facilities, especially those irrigating lawns while yearly rainfall fluctuates.

SOLUTIONS

Adjust Seasonal Dial

The first recommendation is to implement a percent adjustment on irrigation dial clocks based on the minimum irrigation each site needs. Across the 12 facilities, the seasonal dial could be reduced to 5% to 75% depending on the facility. This solution simply requires changing the setting on the irrigation controller or system. To implement this recommendation, the facilities management would lower the percentage by a certain amount (e.g., 10%) on a weekly or biweekly basis. If a lawn appears to look and feel healthy with 10% less water, the run time could be further decreased until it gradually reaches a recommended percentage or the turfgrass appears to need more water.

"We greatly appreciated working with MnTAP and our intern, Lucy, for the summer. Without their expertise, we would not have had the capacity to dig into seasonal trends in water use. Even though this was a short-term project, the potential savings, both cost and environmental, are enormous!"

~ Caroline McFadden,
Enterprise Sustainability Planner,
Office of Enterprise Sustainability (OES)

Solutions

Implement Irrigation Deduct Meter

For systems without an irrigation specific meter, they should install a deduct meter. Having an irrigation specific meter will allow a site to accurately track their irrigation use as well as deduct this use from their sewer bill to reduce costs. Knowing how much water is used for specific purposes gives both the site and OES more comprehensive data about water use, and this could help calculate water reduction opportunities.

Install Weather Stations, Rain Sensors, or Soil Moisture Sensors

Automating a site's irrigation system by adding sensors based on weather data, rainfall, and soil moisture can prevent overwatering or watering during unfavorable conditions. These sensors set irrigation levels or override irrigation controls based on predicted rain, sensed rainfall, or soil moisture. While it is difficult to quantify water and cost savings associated with these recommendations, they can reduce unnecessary irrigation and reduce labor associated with staff manually shutting off irrigation systems.

Implement Lawncare Best Practices

Implementing lawncare best practices will promote drought-tolerant and healthy lawns. Raising the mowing height of turfgrasses to a minimum of 3 inches helps promote longer roots while removing one-third or less of the grass length minimizes stress on grass. These practices can reduce mowing frequency. Additionally, choosing grasses that fit the lawn's purpose can optimize lawncare needs. Areas with less foot traffic may benefit from a longer, lower maintenance grass, such as a fescue grass.

This table gives water and cost savings by agency for adjusting the seasonal dial and/or implementing an irrigation deduct meter as needed by each site.

Agency	Annual Reduction	Annual Savings	Status
Administration	2,820,000 gal water	$25,700	Recommended
Corrections	4,100,000 gal water	$23,900	Recommended
Human Services - DCT	2,740,000 gal water	$10,300	Recommended
Labor & Industry	110,000 gal water	$1,200	Recommended
Veterans Affairs	720,000 gal water	$20,500	Recommended

MnTAP Advisor: Laura Sevcik, Engineer

MN Department of Corrections, Shakopee

Solutions

Danielle Jakob
Sustainable Systems Management
University of Minnesota Twin Cities

Organization Background

Minnesota Department of Corrections oversees 11 facilities comprising 7.5 million square feet and an annual energy footprint of 6.83 metric million therms. Minnesota Corrections Facility-Shakopee (MCF-Shakopee) is Minnesota's only facility for housing incarcerated women and has a maximum capacity of 676 incarcerated individuals at all security levels. At 255,872 square feet of buildings with 32.2 acres of open land, the facility operates with an annual budget of approximately twenty million dollars. MCF-Shakopee averages 562 incarcerated people and covers all security, nutritional, educational, medical, recreational, spiritual, therapeutic, and transitional needs of those serving out their sentences.

"It's been a remarkable experience interning for MnTAP this summer, I've gained greater understanding and appreciation for sustainability work being done within Minnesota's state departments, and greater clarity around my career aspirations for the future. Helping the Department of Corrections work toward their sustainability goals has been immensely rewarding. This internship offered me the opportunity to see that sustainability solutions can be directly advantageous to realizing the DOC's vision of restorative justice, racial equity, and community connectedness." ~ DJ

Project Background

This project identified and optimized systems that use large quantities of water and energy in the facility. This project was focused on residential water use, including on-site laundry operations, lighting systems, and kitchen equipment and procedures.

Incentives to Change

The Department of Correction prioritizes security and safety while transforming lives for a safer Minnesota. The facility's leadership is looking to reduce operations costs associated with water and electricity use so that more funds can go towards therapeutic services and educational opportunities and programming. Additionally, the State of Minnesota prioritizes optimizing energy and water use to mitigate climate change.

SOLUTIONS

This project identified more recommendations than could be covered in this executive summary. Please see the table for the full list of recommendations.

Install Low Flow Showerheads

MCF-Shakopee has 56 showers on site with varying fixtures and several different flow rates. This recommendation aligns with the Americans with Disabilities Act (ADA) as well as the needs of incarcerated people. Wherever possible, fixtures labeled by the Environmental Protection Agency as WaterSense should be used. Installing fixtures flowing at 1.5 gallons per minute would save the facility 2,800,000 gallons of water, 21,000 therms of natural gas, and $26,000 annually.

Commingle IP Laundry

MCF-Shakopee currently uses 2,063,000 gallons of water each year for laundering incarcerated people's clothing whereas bed linens are laundered off site. All incarcerated people receive 43 items of state-issued clothing and a large mesh bag upon intake to the facility, and they are responsible for laundering their own clothes. On average, each person does 2.5 loads of laundry per week, which equates to over 73,000 loads of laundry per year for the current population. Using individual mesh laundry bags when washing clothes would keep each person's laundry separate and allow for comingled loads. Implementing a commingle laundry system would save 1,030,000 gallons of water, 260,000 kilowatt-hours (kWh), 1,400 pounds of detergent, 1,600 pounds of scrap metal, and $49,000 annually.

Retrofit Lighting System with LEDs

With eleven buildings and substantial outdoor lighting needed to adequately protect incarcerated people and employees, lighting accounts for 35% of the facility's electricity use, and the total annual electricity bill costs over $470,000. A lighting audit was conducted to inventory the many fixtures and bulb types; 96% of the facility is lit by fluorescent bulbs, which contributes to 1,480,500 kWh demand for lighting each year. Retrofitting the facility to light-emitting diode (LED) lighting would save the facility 600,000 kWh and $80,000 annually.

"Our partnership with MnTAP served as a valuable turning point for achieving our future sustainability requirements. Intern Dannielle did an exceptional job of modeling her findings to meet our unique operational requirements. Her analysis revealed significant water and energy use reduction strategies that are achievable with a short-term ROI. The MnTAP program is very professional, well organized, and provided significant value to our operation going forward."

~ Eric Thomforde
Physical Plant Director, MCF-Shakopee

Recommendation	Annual Reduction	Annual Savings	Status
Low Flow Showerheads	2,800,000 gal water 21,000 therms	$26,000	Implementing
Commingle Laundry	1,030,000 gal water 260,000 kWh 1,400 lbs. detergent 1,600 lbs. scrap metal	$49,000	Recommended
Retrofit Facility with LEDs	600,000 kWh	$80,000	Implementing
Install Ozone	2,900 lbs. detergent	$28,000	Recommended
Replace Dishwasher	19,000 gal of water 120,000 kWh	$11,000	Recommended
Turn off IP Coffee Machines When Not in Use	67,000 kWh	$6,200	Recommended
Replace Gaskets on Freezers and Coolers	1,500 kWh	$150	Implemented

MnTAP Advisor: Logan Wikstrom, Associate Engineer

Niron Magnetics Solutions

Heidi Herrmann
Chemical Engineering
University of Minnesota Duluth

Organization Background

Niron Magnetics is a startup company in Minneapolis, Minnesota that originated from research conducted at the University of Minnesota. Niron's primary product is the Clean Earth Magnet®, the first sustainably produced, high performance, and permanent magnet made from iron nitride nanoparticles. Niron is currently operating its commercial pilot plant and is planning its first full-scale manufacturing plant (Plant 1). Any changes made to the process now will significantly influence how those plans move forward.

"I think Niron Magnetics is a great company that's doing some really exciting things for the future of magnet production. I had a great time at Niron this summer and I learned that this type of work was really fulfilling for me. I appreciate this opportunity and am thankful for the help and support from both the MnTAP and Niron staff I worked with." ~ HH

Project Background

This project is MnTAP's first "sustainable chemistry" internship and is funded by the Minnesota Pollution Control Agency (MPCA). The purposes of this project were to determine a safer alternative to replace methanol, a hazardous and flammable chemical used in the current process, and to determine the feasibility of eliminating solvent use within Niron's manufacturing process.

The following three solvents were selected based on their physical characteristics, hazard profiles, and regulatory requirements: ethanol, isopropanol, and propylene glycol. These solvents were experimented with at the research and development (R&D) scale and samples were compared to a methanol control. All three alternatives produced magnet powder with equal or improved magnetic performance compared to methanol use. A solventless process was also investigated. All economic analyses were based on estimated impacts of proposed process changes on Niron's Plant 1. The analysis presented here is roughly estimated and may not be accurate as the plant design becomes further refined.

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Incentives To Change

Replacing methanol with a less hazardous solvent would improve workplace safety, eliminate a hazardous air pollutant, and remove the need for certain regulatory permits. Eliminating solvent use would be even more beneficial, since it would eliminate the need for a solvent recycling system and significantly reduce waste generation.

A solventless process would also allow for an inherently safer process design by allowing the magnetic powder to remain completely contained within process lines. This would mitigate the risk for nanoparticle and hazardous vapor exposure, and thus, improve process and workplace safety.

"Heidi's successful summer at Niron Magnetics will not only impact the core business, but will have wide ranging environmental implications for many years to come. She has moved the needle on multiple high impact processes far beyond her years of experience."

~ Nick Umland, EHS Manager

Replace Methanol with Ethanol

Replacing methanol with ethanol would require no procedural changes and produces powder with improved magnetic performance compared to methanol. Ethanol is less hazardous in terms of toxicity and is not considered a hazardous air pollutant. Solvent expenses are estimated to be increased by $540,000 at start-up and $620,000 annually, since ethanol is more expensive than methanol. This cost increase is partially offset by an estimated $430,000 decrease in energy costs.

Replace Methanol with Isopropanol

All investigated solvents could be viable alternatives to methanol within Niron's process. Although isopropanol and propylene glycol required some procedural changes within the process, the results of this project indicate that certain solvent properties have interesting impacts on the magnetic nanoparticles. Isopropanol is likely the best option in terms of overall cost savings, environmental or safety impact, and ease of implementation within the established process. Further research is recommended to ensure selection of the best option.

Eliminate Solvent Use

Implementing a solventless process would be a significant process change that could lead to substantial benefits to process safety, and capital and operating expenses. Capital expenses are estimated to be reduced by $16,290,000 through a decrease in equipment costs, permit requirements, and solvent use. Operating expenses are estimated to be reduced by $5,480,000 annually through a decrease in waste generation, energy consumption, permit requirements, and solvent replenishment. Alternative equipment without solvent use was employed to gather preliminary data on the effects of varying certain parameters. The analysis concludes that implementing a solventless process could be feasible but further research is recommended..

Recommendation	Annual Reduction	Annual Savings	Status
Replace Methanol with Ethanol	4,570,000 kWh	$0	Implementing
Replace Methanol with Isopropanol	2,700,000 kWh	$300,000	Recommended
Eliminate Solvent Use	13,660,000 kWh 3,650,000 lbs	$5,480,000	Recommended

MnTAP Advisor: Jane Paulson, Senior Engineer

PTC Steel Solutions

Julie Van
Sustainable Systems Management
University of Minnesota Twin Cities

Organization Background

PTC Steel – Minneapolis was founded in 1924. It is a leading producer of Electric Resistance Welded (ERW) and Drawn Over Mandrel (DOM) mechanical steel tube. Tony Bolz manages the plant, and the plant produces over 32,000,000 pounds of tube per year.

"My experience with MnTAP and PTC Steel this summer has been an absolute blast! I have never learned so much in such a short period, and I have gained a deeper understanding about the sustainability space in the context of manufacturing and industrial systems. I am excited for the things I have learned, and I am very grateful to be able to experience this awesome opportunity." ~ JV

Project Background

The plant partnered with MnTAP with the goal of using less water to cool production equipment. The first half of the project consisted of creating a comprehensive water map with water usage and water flow rate quantified. Using flow rates and run times, the annual water usage for each process was calculated or estimated if there was a lack of information or access to the drainpipes. It was identified that 81% of water usage in the facility was single pass cooling water from the well, which signified this area as the largest conservation opportunity.

Incentives To Change

PTC Steel believes in being a good steward of the environment and has a strong sense of responsibility to their local community that drives them towards ever greater environmental sustainability.

SOLUTIONS

Install Automatic Solenoid Valves

Installing automatic solenoid valves on 14 pieces of equipment with single pass cooling water would reduce water use on non-production days. Additionally, solenoid valves would be automatic and eliminate the need to manually turn cooling water on and off. This would save 25,000,000 gallons of water and $137,000 in costs annually.

Repair the Water Softener and RO System

The tube water softener and RO system filter water for the tube mill coolant tank and use about 64,900 gallons annually. An investigation revealed that the system constantly discharged water due to a broken piston. The system also consumed more salt than necessary. Repairing the system would save 4,500,000 gallons, 2,050 pounds of salt, and $56,000 annually.

Change Rinse Tank Flow Rate to 0.5 GPM

The rinse tank on the cleaning line was flowing at 5.3 gallons per minute (GPM) because of a broken flow meter. Replacing the flowmeter would solve this problem. In the meantime, the flow has been manually lowered to 0.5 GPM and, thus, will save 2,450,000 gallons and $29,800 per year.

Turn Off Rinse Tank on Off Days

The same rinse tank was running on non-production days. Turning the flow off during weekends and holidays will reduce usage by 196,000 gallons and $2,400 per year.

Turn Off Cleaning Line Burners on Off Days

Natural gas burners maintain the alkaline and rinse tanks at their setpoints. However, the tanks are not needed if the plant is not operational. Turning the burners off on non-production days is conservatively estimated to save 3,600 therms and $1,800 annually.

Install Lid For Alkaline Cleaner Tank

The alkaline tank currently loses heat through evaporation. Adding a lid for the tank is estimated to reduce these losses by approximately 70%, or around 7,900 therms, and save $3,900 annually.

"Working with Julie was great! She is very motivated and did a wonderful job! Not only did she identify places we were using too much water, but she also educated our team. Julie used all her resources here and at MnTAP to solve problems and suggest better practices moving forward. It's amazing the amount of money that can be saved if you are looking. A great experience and we can't wait to work with MnTAP again"

~ Tony Bolz, Plant Manager

Recommendation	Annual Reduction	Annual Savings	Status
Install Automatic Solenoid Valves	25,000,000 gal water	$137,000	In Progress
Repair the Water Softener and RO System	4,500,000 gal water 2,050 lbs salt	$56,000	Implemented
Change Rinse Tank Flow Rate to 0.5 GPM	2,450,000 gal water	$29,800	Implemented
Turn Off Rinse Tank on Off Days	196,000 gal water	$2,400	Implemented
Turn Off Cleaning Line Burners on Off Days	3,600 therms	$1,800	Implemented
Install Lid For Alkaline Cleaner Tank	7,900 therms	$3,900	Researching

MnTAP Advisor: Gabrielle Martin, Engineer

Puris Proteins

Roman Lidyaev
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

Puris Proteins was founded in 1985, and for nearly 40 years, it has served its mission to develop a more sustainable and plant-based approach to food production. In 2018, the company rebranded as PURIS and formed a joint venture with Cargill, Incorporated to expand its pea protein production capabilities. This partnership enabled the purchase and retrofitting of a large facility in Dawson, Minnesota, and this facility is now the largest operating processing plant for yellow field pea protein in North America.

"I am grateful to MnTAP and PURIS for the opportunity to work together and be exposed to advanced and lean operations within the food industry, contributing to the ongoing efforts to enhance the efficiency of processes and complex equipment. Through this experience, I gained valuable insight into sustainability practices." ~ RL

Project Background

PURIS has worked extensively in perfecting the core processes of production, maximizing reuse of water, and improving efficiency. The team at the Dawson plant had identified areas they felt were the most promising and wanted to dive deeper in.

Incentives To Change

As a leader in sustainable food production, PURIS continually strives to reduce its environmental footprint. Now that PURIS' facility has been set up and in operation for several years, it can focus more on exploring opportunities to tweak and fine-tune the equipment for even more efficient, cost-effective operations.

> *"Roman took ownership of projects and collaborated with our on-site operations and management teams to complete them, while requiring little guidance from me. Roman and the MnTAP program identified new energy savings opportunities, gave us different perspectives on known opportunities and quantified payback so we can re-align our improvement priorities."*
>
> *~ Brandon Eddy, Utilities Engineer, Puris Proteins*

Solutions

SOLUTIONS

Upgrade Spray Nozzles

Low flow nozzles can be used for clean-in-place (CIP) washdown stations and would save 280,000 gallons of water and $4,500 annually.

Insulate Spray Dryer

The spray dryer was originally designed to be insulated, but the insulation was never installed. Applying insulation could reduce natural gas usage by 38,000 therms and save $15,800 annually.

Optimize Baghouse

The pulse jet cleaning system is the main user of compressed air. The baghouse is the largest piece of equipment in the plant and has more than 100 filters cleaned by compressed air. Each pulse takes fractions of a second, but when repeated thousands of times a day, can lead to significant energy demand.

To reduce energy use, it is recommended to reduce pulse duration by a maximum of 0.4 seconds and increase the pulse delay by a maximum of 10 seconds. It is also recommended to optimize the pulse sequence and control automation. Implementing each action will decrease the savings from carrying out the other actions. Therefore, full implementation would reduce air usage by up to 90% or 400,000 kWh and $14,000 per year. However, this is a theoretical estimation, and in reality, the total energy and savings will be somewhat lower than that amount.

Install Capacitor Bank

Demand charges make up a significant part of the electricity bill at the plant. Using a capacitor bank would reduce these costs and save up to $82,000 annually.

Update Boiler Infrastructure

Boilers are running around the clock to provide steam that is necessary for multiple applications in the plant. Proposed upgrades and synchronization of the equipment controls could save up to 380,000 therms and $155,000 annually.

Institute Regular Steam Trap Audit

As the plant's steam traps reach their end of life, a routine inspection procedure should be implemented for timely identification and repair of faulty traps. This could potentially save up to 1,770,000 gallons of water; 138,000 therms of natural gas; 5,300 kWh; and $65,000 annually.

Recommendation	Annual Reduction	Annual Savings	Status
Upgrade Spray Nozzles	280,000 gal water	$4,500	Recommended
Insulate Spray Dryer	38,000 therms	$15,800	Recommended
Optimize Baghouse (duration) by a Maximum of 0.4 Seconds	180,000 kWh	$6,300	Implemented
Optimize Baghouse (delay) by a Maximum of 10 Seconds	67,000 kWh	$2,300	Recommended
Optimize Baghouse (sequence)	11,000 kWh	$400	Recommended
Optimize Baghouse (control automation)	11,000 kWh	$400	Recommended
Install Capacitor Bank	N/A	$82,000	Recommended
Update Boiler Infrastructure	380,000 therms	$155,000	Recommended
Institute Regular Steam Trap Audit	1,770,000 gal water 138,000 therms 5,300 kWh	$65,000	Recommended

MnTAP Advisor: Gabrielle Martin, Engineer

Second Harvest Heartland

Gehna Jain
Computer Science
University of Minnesota Twin Cities

Organization Background

Second Harvest Heartland (SHH) is the third largest food bank in the United Sates with a 233,000 square feet facility in Brooklyn Park, Minnesota. SHH covers 59 counties in Minnesota and Western Wisconsin, and it employs over 280 people. As part of its "Make Hunger History" plan, SHH aims to cut hunger for all Minnesotans in half by 2030.

"This summer has been an incredible learning experience, deepening my understanding of supply chain processes, logistics, data-driven decision-making and large-scale food recovery operations. In addition to my professional growth, I have also gained insight into the differences between academic projects and the complexities of working in a large-scale organization. I am sincerely grateful to MnTAP and Second Harvest Heartland for this opportunity." ~GJ

Project Background

SHH worked with MnTAP on a preliminary greenhouse gas (GHG) inventory of its food distribution model in late 2023, and that project spurred the creation of this internship. This internship's primary goal was to decrease SHH's GHG emissions and air pollution across its fleet, and its secondary goal was focused on reducing food waste.

Incentives To Change

SHH has a strong commitment to sustainability and minimizing its daily operation's environmental footprint. Feeding America is also cutting its freight subsidy to SHH by 90%, which means SHH will have to make up this difference on its own if it does not reduce its current fleet use.

Since SHH has forecasted to source 23 million more pounds of food in the coming fiscal year; ensuring that this growth will be handled efficiently was a key objective of the internship. On average, SHH serves 70 to 80 agencies each day, and it has over 780 agencies in its portfolio. This makes it crucial to optimize fleet services and enhance operational efficiency.

SOLUTIONS

5 Backhauls Per Day

SHH sends at least 15 trucks each day and transports an average of 300,000 pounds of food. After completing deliveries, the trucks return to the warehouse empty. This means despite drivers being paid for the entire shift and fuel costs remaining at $9.05 per mile, these return trips do not transport anything. There is thus an opportunity to schedule pickups from food sources on the drivers' way back and eliminate the need to schedule additional truck pickups from these food sources. This would help cut down fuel costs and improve driver efficiency in transporting food.

"Gehna joined us eager to learn and quickly demonstrated her strong work ethic, initiative, and creativity. Gehna's contributions to our nonprofit's mission to combat hunger provided her with valuable real-world experience, while we also gained valuable insights into data science and its practical applications."

~ Paul Jacobs, Director of Transportation

Solutions

Theoretically, SHH can make as many as 12 to 13 backhauls (i.e., when a commercial truck returns to its starting destination with cargo) a day. However, the more realistic scenario of five backhauls per day was recommended.

Increase Pounds Per Mile by Widening Delivery Windows

SHH delivers to agencies, and these agencies have the freedom to choose a time window of when they could accept the delivery. This means that even if two agencies are next to each other, SHH drivers can only deliver to both on the same route if they chose overlapping time windows. This complicates routes and makes the drivers travel in a non-optimized manner. An analysis of the transport and sales data revealed that if certain agents widened their delivery windows to a minimum of three hours, then the routes would become simpler. This allows SHH to route less while carrying the same weight and increasing pounds per mile by 13%. Since the organization is exponentially increasing, a higher pounds per mile ratio will help SHH handle surges in food rescue more easily.

The next three recommendations came from auditing the waste generated by one of SHH's 780 portfolio clients.

Divert Expired Liquid Waste to Anaerobic Digestion

Fifty-eight percent of this client's waste was liquid and could be diverted to anaerobic digesters. This waste was mainly comprised of dairy product.

Divert Expired Non-liquid Waste to Compost on Site

Forty-two percent of the non-liquid waste was found to be grains and prepared food produce. This non-liquid waste should be removed from its packaging, which reduces contamination, and continually composted outside with proper pile rotation and aeration.

Set Out Items for Donation at Curbside

Some of that 42% of non-liquid waste was not expired, and the client was disposing of it simply because they lacked space for these products. They could advertise this excess, unexpired product to the public for curbside access and pickup.

Recommendation	Annual Reduction	Annual Savings	Status
5 Backhauls Per Day	53,000 miles 56.5 MTCO2e avoided	$660,000	Recommended
Increase Pounds Per Mile by Widening Delivery Windows	48,000 miles 51.5 MTCO2e avoided	$435,000	Recommended
Divert Expired Liquid Waste to Anaerobic Digestion	36,000 lbs waste	TBD	Recommended
Divert Expired Non-liquid Waste to Compost on Site	16,900 lbs waste	TBD	Partially Implemented
Set Out Items for Donation at Curb Side	9,600 lbs waste	TBD	Recommended

MnTAP Advisor: Jon Schroeder, Waste Specialist

Director's Note

On behalf of the entire MnTAP team, I'm thrilled to share the incredible work of our 2024 MnTAP Interns. This publication highlights the executive summaries of the projects completed by our 14 talented interns over the summer. Their efforts focused on reducing waste, minimizing hazardous materials, conserving water and energy, and ultimately saving money while delivering high-quality products and services. As you read through these pages, we are certain you will be impressed by the scale and scope of recommendations this year's interns put forward to their companies.

Our interns came from diverse degree programs and personal backgrounds, bringing unique skills and perspectives to tackle projects with significant environmental and business impacts. Over 13 weeks, they transformed from young professionals into experienced project managers, achieving tangible, measurable outcomes. They also had the opportunity to begin building their professional networks, starting within the cohort itself.

Of course, each summer brings its own set of opportunities and challenges, and this summer was no different. Despite these inevitable speed bumps, each of our interns demonstrated professionalism and a tenacious can-do attitude, providing their respective companies with impressive recommendations and results. As we watched them grow, pivot, and thrive in their new environments we were continuously impressed with their current skills and obvious future potential. With this summer behind us, we can once again confidently say that we will be in great hands as these students step into the next phase of their careers. For those who may be interested in connecting with these gifted young professionals, please let us know!

Beyond the talented interns we hire each summer, this program's strength lies in its many dedicated partners. These projects cannot occur without the willingness of companies to welcome our interns into their facilities and allow them the space and opportunity to bring forward their questions and be open to making changes. It's continuously impressive to see the growth in both the interns and their companies and witness the amazing outcomes that come from those journeys.

Similarly, this work could not occur without the financial support and confidence of our partners who fund the MnTAP program. It is through this generous support that we have the opportunity to train the next generation of pollution prevention practitioners and help the businesses and organizations in the State of Minnesota be more efficient with their resources. We are so lucky to have such ardent support from our partners, and are truly thankful for these relationships.

We hope you enjoy exploring the solutions presented here and are inspired by their impact. For those of you who have your own business, we hope this may provide you with some ideas to implement at your location or encourage you to apply for your own MnTAP intern. For those interested in applying, the application period for the 2025 Intern Program is open, with applications due January 17, 2025. These applications are available on our website at: www.mntap.umn.edu/interns/business/howtoapply

In short, thank you to all who helped make the 2024 Intern Program a success. We couldn't do it without you!

Sincerely,

Kelsey Klucas, MnTAP Director

Accomplishments

40 YEARS of MnTAP
Here's what we've accomplished since 1984

117 MILLION kWh + 6.2 MILLION THERMS

MnTAP helped Minnesota businesses conserve the natural gas equivalent to driving around the earth 3,400 times and electricity generated by 21 wind turbines.

900 MILLION GALLONS OF WATER

Enough water to create the artificial snow for the 2022 Beijing Olympics 3 times!

404 MILLION POUNDS OF WASTE

MnTAP-recommended solutions have helped MN businesses save the equivalent of the annual waste generated by all of the people of Bloomington, Burnsville, and Apple Valley combined.

$58 MILLION

Implementing MnTAP recommendations has saved Minnesota businesses a lot of money – over $1.5 million per year

5,200 SITE VISITS

Engineers and specialists travel across the state to help Minnesota companies find industry-tailored solutions.

367 INTERNS, 325 COMPANIES

Students from 31 different colleges and universities, advised by MnTAP technicians, have been deployed to companies across the state. These interns have served facilities large and small across industries such as manufacturing, food processing, health care and hospitality

5,300 EXCHANGES

Users of the Materials Exchange have diverted 53 million pounds of waste from landfills, saving money.

Resource Efficiency | MnTAP | Pollution Prevention

MnTAP SOLUTIONS

About MnTAP

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

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

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

Matt Domski
Intern Program Manager

Kelsey Klucas
Director

Jocelyn Leung
Communications Specialist

Gabrielle Martin
Engineer

Ashwin Nambudiripad
Associate Engineer

Jane Paulson
Senior Engineer

Kevin Philpy
Senior Engineer

Alaina Ryberg
Web & Database Administrator

Jon Schroeder
Waste Specialist

Laura Sevcik
Engineer

Jon Vanyo
Senior Engineer

Logan Wikstrom
Associate Engineer

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Minnesota Technical Assistance Program
McNamara Alumni Center • University of Minnesota
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612-624-1300 | www.mntap.umn.edu