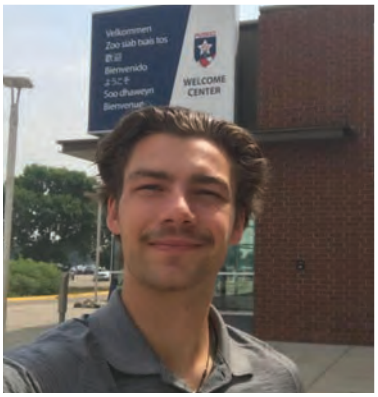
MnTAP

SOLUTIONS

2021 MnTAP Intern Program



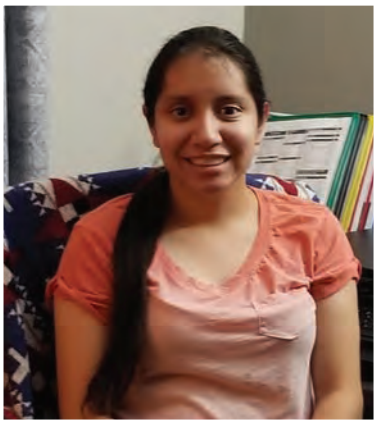









"My internship was an amazing experience. I was able to learn about an entirely new branch of production work as well as collaborate with knowledgeable staff on developing and implementing new projects."
~ Gabriella Martinez-Zamora, Faribault Woolen Mills



MnTAP

Table of Contents

Intern Projects

Project Focus Key

 Chemicals

 Electricity/ Natural Gas

 Water

 Waste

MnTAP thanks our generous partners who make this vital work possible. Each of these organizations contributed financially to the intern program in 2021. Their support helps maintain our continuing pollution prevention, energy efficiency and water conservation work.

"The Metropolitan Council is proud to again be associated with such a stellar group of summer interns. With the expert guidance of MnTAP engineers and scientists, these interns identified millions of gallons of water savings at area businesses. And with our region in the midst of a drought, this work has never been more important."

~Brian Davis, Senior Engineer
Metropolitan Council Environmental Services

"Xcel Energy is honored to continue to foster our relationship with the MnTAP Internship program. We (Xcel energy) truly value the premium energy savings projects that have been revealed by the students and executed by the customers. Furthermore, we appreciate your involvement in developing and informing the next cohort on sustainability, energy efficiency, and waste reduction. MnTAP has provided a pipeline for success for many years to come"

~ Jakai Taylor
Senior Product Portfolio Manager, Xcel Energy

"The fourteen projects that made up this year's intern program were truly impressive, ranging from developing best practices for industrial water softening to reducing chloride pollution in our state's waters to identifying a novel solution to solid waste generated at an ammunition proving grounds for a defense contractor. As always, the interns displayed great technical skills and professionalism with their projects, with recommendations that can save a combined $1,078,000 year. Any manufacturing or industrial company could benefit from a program like this."

~ Mark Snyder, Pollution Prevention Coordinator
Minnesota Pollution Control Agency

"We always enjoy receiving the summer intern updates from MnTAP. Not only do these students always achieve fantastic results in upstream nutrient reduction for their host organization, but their work also helps the entire host community achieve more affordable, maintainable wastewater treatment."

~ Legislative-Citizen Commission on Minnesota Resources

2021 Intern-Proposed Solutions

Recommendation	Reduction	Cost Savings	Equivalents (annual)
Water Conservation	24,000,000 gallons	$74,000	Water for more than 1,000 Minnesota residents
Waste	630,000 lbs	$410,000	Annual waste from 300 Minnesota residents
Chemicals	190,000 lbs	$60,000	Nearly 400 55 gallon drums
Electricity	4,000,000 kWh	$430,000	Electricity for 2,800+ Minnesota homes
Gas	200,000 therms	$90,000	CO_2 emissions from 220 passenger vehicles
Production Impacts	---	$14,000	---
Total Potential Cost Savings	**---**	**$1,078,000**	**---**

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

Be Part of the 2022 Intern Program

A History of Success

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

Interns Have Far-Reaching Impact

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

Companies Reap Rewards

More than 364 companies have been served by the program. Interns have worked with industries such as hospitality, healthcare, manufacturing, and food processing. The bottom line is MnTAP intern projects result in solutions that positively impact a business and reduce its environmental footprint.

Sign Up Now

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

Now is the time to start thinking about developing a project for next summer. Applications are accepted until **February, 2022**.

CHS

Sam Matuseski
Chemical Engineering
University of Minnesota Twin Cities

Company Background

CHS is an agricultural cooperative with businesses in grain, feed, fertilizer, and energy. The cooperative structure means that local cooperatives and farmers own the company. They currently have about 10,000 employees. CHS operates farms that grow grain and other crops and purchases crops from local farmers for distribution, as well. They manage an extensive network that processes this grain into ethanol and distributes grain and ethanol globally. They also produce a range of food and animal feed using soybean, canola, and other crops. CHS is headquartered in Inver Grove Heights and its locations span the globe.

"In a world facing accelerated sea level rise, more intense storms, and rising temperatures, climate change has been brought to the forefront of society's concern. I have always been passionate about making an impact in this space and MnTAP provided me a great opportunity to do so. This experience has taught me skills and provided tools that I will use for years to come." ~ SM

Project Background

CHS has begun to tackle some sustainability projects, but wishes to establish a more robust, company-wide sustainability program. In the last year, CHS formed an energy council and a few locations in Minnesota have started professional energy audits, as well as tackling LED projects that have already realized cost savings. Their headquarters is very energy efficient, as many of the energy saving opportunities identified have been implemented. With many of the locations needing more information about the cost of energy and potential energy savings projects, CHS looked to a MnTAP intern for help.

Incentives to Change

The biggest incentive to change for CHS are the cost savings associated with reducing energy consumption across facilities. Annual energy expenses for its facilities add up to about $3 million, which is equal to about 25 million kWh. CHS also wants to become a more sustainable company and establish an on-going sustainability program. With interests in energy and agriculture, the company needs to be forward-thinking amid the current climate. More CHS business partners are requiring that they have sustainability work documented to continue relationships. The work of the MnTAP Intern Project will be used to decide what the best sustainable solutions are to implement countrywide.

SOLUTIONS

Install LED Lighting

All existing metal halide, fluorescent and incandescent lamps are recommended to be replaced with LED lighting. Motion sensors could also be added to areas where foot traffic varies throughout the day to see additional savings. Some lighting projects are in the process of being implemented and some are still at the status of recommended. Implementing these projects at all 3 locations would reduce the electricity usage by 74,000 kWh and save $13,500 annually.

"Sam was a great addition to our team and we really appreciated his help this summer. I hope that he got as much enjoyment from his internship as we did.

~ Stephanie Simms
Environment Specialist, CHS

Solutions

Fix Compressed Air Leaks

Compressed air leaks are causing compressors at locations to run for longer times than necessary. Fixing the 16 leaks at all 5 locations will result in 32,000 kWh in energy savings, which corresponds to $4,500 in cost savings. These projects have little to no cost associated with them. Installation of zero loss drains to replace the electric solenoid drains at the St. Charles location would result in additional energy savings.

Install VFDs on Grain Piles

The fans used in grain piles run at 100% speed, 24/7, for months at a time, which is a significant energy expense for locations. It is recommended that the location install VFDs on these fans which ramp the speed up or down based on the wind speed. Installing VFDs at the 9 locations with grain piles would result in 1,595,000 kWh in energy savings and $223,000 in cost savings.

Implement Changes Recommended from Audit

A professional energy audit was conducted at the Ruthton location. The report is still under review, but it is recommended that the location implement all energy saving opportunities identified by this audit.

Recommendation	Annual Reduction (kWh/yr)	Annual Savings	Status
Install VFDs at 9 locations	1,595,000	$223,000	Recommended
Install LED lighting at 3 locations	74,000	$13,500	Implementing
Fix compressed air leaks at 5 locations	32,000	$4,500	Implementing
Implement changes recommended from audit	TBD	TBD	Recommended

MnTAP Advisor: Michelle Gage, Engineer

Faribault Woolen Mill Co.

Gabriella Martinez-Zamora
Bioproducts & Biosystems Engineering
University of Minnesota Twin Cities

Organization Background

Founded in 1865, the Faribault Woolen Mill has been around for generations, producing quality fabrics such as blankets and scarves from start to finish. The longevity of this company has provided a consistent image in the community, especially due to the fact that it's now one of the few vertical mills in the United States. Much of the fabric-making process has stayed the same way for decades, which has allowed for both process technique and artistry to go into the making of products.

"My internship was an amazing experience. I was able to learn about an entirely new branch of production work as well as collaborate with knowledgeable staff on developing and implementing new projects. I was able to accomplish way more than I expected and am so grateful for this opportunity. ~ GMZ

Project Background

Vertical fabric mill textile manufacturing is a water intensive process. Faribault Woolen Mill consumes around 10 million GPY of water supplied by the City of Faribault. Mapping water use in the facility provides an opportunity to identify the major water consuming operations and prioritize the highest consuming areas for evaluation. This optimization will very likely allow both lower company costs and increased productivity.

With a production site that has been around over 150 years, much of the staff have been trained by knowledgeable members with years of experience. However, with production increasing the mill seeks an effective way to quickly and consistently train new employees. Additionally, the equipment used is often older but functional, so careful documentation of equipment operation and effective staff training on standard procedures will maximize productivity and help extend equipment life.

Incentives to Change

Investment in water efficiency will result in reductions of both municipal water and sewer costs as well as lower energy use from reduced water heating. Since the mill averages about 10 million gallons of water used annually at $0.005 per gallon, water conservation will save the facility tens of thousands of dollars. Improvements in standard work can allow for better consistency and fewer delays, which will lead to better work flow and overall productivity.

SOLUTIONS

Soap Reduction & Optimization

In discussion with vendors, it was discovered that the mill was using too much soap for fulling and washing that required excess water use to rinse out of the fabric. Soap use was gradually decreased with careful observation of product performance. A 75% reduction in soap and at least 68% reduction in water can be reliably implemented long-term. Overall savings will occur from reduced water usage and heating as well as from reduced annual soap costs. Reduction in rinse times will increase productivity due to quicker load processing.

Optimize Rinse Cycling

Since the wet processes (washing, fulling, and piece dyeing) utilize the most water from the plant, adjusting all three to the most efficient rinse process will save water. The most efficient way to rinse is to turn off the water until the tank is fully drained, and then to refill the rinse basin after. This standard operating procedure saves 4 minutes of water flow time per load. This results in a water savings of 300,000 GPY.

Solutions

Wet Process Documentation & Organization

This process will reorganize the methods for washing, fulling and dyeing such that steps for most specific cases of fabric processing are easily found and clearly detailed. By reorganizing existing documentation and collecting unwritten process information into easy to access binders and folders, wet processes can be completed with consistent high quality. This will allow for better preparations for batch consistency as well as improved worker training and accountability. The detailed work instructions allow new members to reference work patterns quickly and independently, saving time and maintaining worker focus on work tasks.

Water Heater Optimization

To better organize the simultaneous use of multiple washing or fulling machines, this solution will determine the optimal way to use the current water heater. This will not only allow for more efficient use of the limited heated water supply on busy production days, but also determine the limitations for future expansion. Calculations were completed to determine the number of washing processes that can run at any given time, and to develop a strategy of staggering wash cycles to ensure consistent hot water availability throughout the production day.

"Our MnTAP intern was professional, worked well with all our staff, and was diligent in her research. Through her project she was able to identify significant water conservation and annual savings for our company. Having a MnTAP intern for the summer was a great experience for our company and the staff members she interacted with. Our experience with this program was a very positive one and we would definitely participate in this program again. This was a great learning experience for everyone involved."

~Joyce Raesner, VP of Production
Faribault Woolen Mill Co.

Recommendation	Annual Reduction	Annual Savings	Status
Optimize Soap Usage	3,500,000 gal water 17,200 lbs. soap 14,700 therm 650 rinse hours	$65,900	Implemented
Optimize Rinse Cycling	360,000 gal water	$3,000	Recommended
Document Wet Processes	Avoid work stoppage	$3,000	Implemented

MnTAP Advisor: Jon Vanyo, Engineer

General Mills

Abby Reinert
Bioproducts & Biosystems Engineering
University of Minnesota Twin Cities

Company Background

General Mills, Inc. is a multinational manufacturer and marketer of branded consumer foods with headquarters in Golden Valley, Minnesota. The James Ford Bell Technical Center (JFB) is the global research and development facility for General Mills. All General Mills products are innovated at JFB, so there are several pilot plants for testing and scale up. Products from Nature Valley, Cheerios, Blue Buffalo, and many more brands are produced there. The facility hosts over 900 employees and is over 720,000 sq. ft.

"This internship has been an amazing opportunity for me. I have always loved the idea of working in the food industry, and it has been extremely rewarding to contribute to making food production more sustainable. This program allowed me to take control and lead my own project, as well as encouraged me to reach out to people. I am excited to work on and lead more projects in the future."~ AR

Project Background

Food research and development is a dynamic environment with a strong reliance on water. About 27 million gallons of well water are used per year at JFB. General Mills is committed to improving the sustainability of water use throughout its supply chain. This project focused on developing a water balance for the facility and identifying opportunities to conserve water.

Incentives To Change

As a leader in the food industry, General Mills is dedicated to responsible water stewardship. The company is devoted to improving the sustainability of its water consumption throughout its supply chain. Each General Mills facility is committed to reducing its water consumption by 1% annually. This project focused on water conservation at the facility level.

SOLUTIONS

RO Reject Recycling

Reject water from the Reverse Osmosis (RO) System could be reused in the backwash and brine steps in the regeneration of the water softeners on site. This would save about 300,000 gallons of soft water per year, with an associated value of $3,800. The high sodium concentration in the RO Reject would also reduce the need for sodium chloride in the brine tank.

Low Flow Nozzles

Currently, a 5.7 gpm nozzle is used to spray 180°F water during sanitation. Replacing the current nozzles with a 3.8 gpm low flow model would save approximately 38,000 gallons of water and 480 therms per year.

Aqueous Ozone Sanitation

Ozone is a strong oxidizer, with powerful sanitizing properties. Integrating aqueous ozone into the sanitation process would reduce the chemical waste and water usage associated with the process. Savings quantifications are under investigation

Hand Sink Aerators

Changing the flow rate of the aerators on the hand sinks in the pilot plants from 1.85 gpm to 1.0 gpm would reduce the water used for hand washing by 46%. Replacing the aerators in the Blue Buffalo Pilot Plant alone would result in about 840 gallons of water and 2 therms of energy saved per year.

Solutions

Upgrading Toilets

At JFB, 57% of the toilets are older 3.5 gpf models. Upgrading these toilets to dual flush (1.1/1.6 gpf) or single flush (1.28 gpf) models would save about 640,000 gallons of water and $4,600 per year.

Optimized Free Chlorine Testing Process

The free chlorine testing process was optimized to reduce water use. The procedure was changed from requiring a water temperature of 55°F to running the water for 3-5 minutes before testing. Since achieving 55°F required running the water for about 1 hour, this will save 8,200 gallons of water and $110 per year.

Stormwater Collection System

JFB has a rainwater collection potential of about 4 million gallons per year. Stormwater could be collected and stored in an empty 1-million-gallon tank in the older chiller plant to use for irrigation.

"Abby came into our facility where she developed a water-use budget, investigated the costs associated with our water, and conducted a study on water usage in our research and development areas. She worked hard to leverage internal and external resources and diligently pursued water conservation solutions. Abby and her MnTAP advisors added value by evaluating our existing program and ideating on innovative ways that we can reduce our water consumption. This was a very good experience and we were very impressed."

~ Nathan Gruman, Safety & Environmental Lead

Recommendation	Annual Reduction	Annual Savings	Status
RO Reject Recycling	300,000 gallons	$3,800	Recommended
Low Flow Nozzles	38,000 gallons 480 therms	$700	Recommended
Aqueous Ozone Sanitation	TBD	TBD	Proposed
Hand Sink Aerators	840 gallons 2 therms	$10	Recommended
Upgrading Toilets	640,000 gallons	$4,600	Recommended
Optimized Free Chlorine Testing	8,200 gallons	$110	Implemented
Stormwater Collection	1,600,000 gallons	$3,000	Future Opportunity

MnTAP Advisor: Laura Sevcik, Pollution Prevention Specialist & Brent Vizanko, Associate Engineer

Great Lakes Coca-Cola

Muhammad Fawad Khan
Chemical Engineering
University of Minnesota Duluth

Company Background

Great Lakes Coca-Cola Bottling (GLCC or GLCCB) is a bottler and distributor of various Coca-Cola products. The company operates 29 facilities throughout the region, including 9 bottling plants. The Eagan, MN facility manufactures and delivers Coca-Cola products to vendors in the surrounding area. The facility mixes ingredients sourced from Coca-Cola North America, with water extracted from onsite wells to produce syrup blends for a variety of products. With an area of 640,000 sq ft under the roof, the Eagan facility has a team of 600 employees.

"This internship with MnTAP has given me the opportunity to not only work in a huge industrial setting, but to lead my own project. I had a really fun time working with some great individuals and was happy to see that I was able to do my part and actually make an impact towards water conservation." ~ MFK

Project Background

One can of a regular soft drink is 90% water. One can of a diet soft drink is 99% water. Given these numbers and the production capability of one of the biggest multinational beverage corporations in the world, it is well known that GLCC facilities have a high water demand. The Eagan facility on its own extracts an estimated 140 million gallons of water per year using two onsite wells and purchases about 15 million gallons per year from the City of Eagan.

Incentives To Change

Last year, approximately 68% of the total water extracted and purchased by the site was used in manufacturing product, while the remaining 32% was discharged as wastewater from various processes. Over the past several years, the Eagan facility has reduced their percentage of total water discharged from above 50% more than a decade ago down to 32% last year. The company wants to continue to improve their overall sustainability score by further reducing this number. GLCC Eagan partnered with MnTAP on a 2021 intern project with the primary goals of reducing overall site water usage, optimizing facility processes, and reducing various utility costs.

SOLUTIONS

Bottle Rinser Flowrate Reduction

On the bottling lines at the Eagan facility, the bottles are blow molded into shape using In-Line Blow Molding (ILBM) technology. They are then rinsed with chlorinated water right before they enter the product filler. This bottle rinser is located on two bottling lines and has a flow rate of 2.35 gallons per minute. Due to the presence of ILBM onsite, other GLCC facilities have deemed the bottle rinser as being a redundant process. Current experimental results indicate that just by reducing the flowrate for each rinser to 1 gallon per minute, GLCC can save at least 450,000 gallons of water and $1,700 per year.

"Our MnTap Intern, Fawad Khan, was a pleasure to have as part of our team this summer. His eager attitude, coupled with the professionalism and integrity in the way he approached his work, virtually guaranteed the successful outcome that was realized. A very worthwhile experience!"

~ Mark Hammerbeck, QA Manager
Great Lakes Coca-Cola

Solutions

Bottle Rinser Shutoff and/or Removal

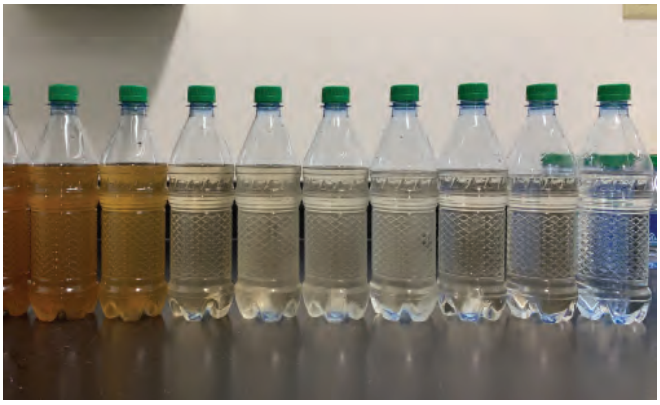
If results from further testing validate the absence of bottle rinsing, the water flow to the rinsers can be turned off completely, leading to a water savings of more than 800,000 gallons and $2,900 per year. The equipment can then be removed and replaced with a continuing length of a simple air conveyor. Equipment removal is a large capital cost, but doing so will eliminate the need for maintaining and cleaning the rinser. In addition to cleaning and maintenance savings, energy savings will be realized due to less equipment and shorter length the bottles have to travel to get to the product filler.

Backwash Time Reduction

Four onsite dual media filter tanks are responsible for removing iron and manganese from incoming well water. These tanks are backwashed twice a week to unclog the filters inside them. Thanks to sampling and lab testing completed during the project, it was found that the set backwash time could be reduced by at least 20% for each tank. This was one of the biggest water conservation opportunities found at the facility. By reducing the backwash time by just 5 minutes across all four tanks, a savings of more than 1,250,000 gallons of water and $4,600 per year can be achieved. This will also reduce the downtime of the dual media tanks and increase overall process efficiency.

Turbidity Sensor Installation

As a further improvement to the previous recommendation, turbidity sensors can be installed in the backwash effluent pipe of each of the dual media tanks, while also implementing process control. The sensors can continuously monitor the turbidity values of the water during the backwash cycle and the process control system automatically halts the cycle when the value reaches a certain set point. With this, the backwash cycle can rely on real-time turbidity readings rather than a preset time. This is the most optimal recommendation, because according to economic calculations, each minute reduced in backwashing amounts to over $900 in savings per year across all tanks. Implementing turbidity sensors would reduce backwash time by 28%–56% and reap annual savings of at least 2,560,000 gallons of water and $9,500.



Recommendation	Annual Reduction	Annual Savings	Status
Reduce bottle rinser flowrate to 1 gpm	450,000 gal water	$1,700	Recommended
Eliminate bottle rinsing stage	800,000 gal water	$2,900	Needs further analysis
Reduce backwash time on dual media tanks	1,250,000 water	$4,600	Implemented
Install turbidity sensors on dual media tanks	2,560,000 water	$9,500	Recommended

MnTAP Advisor: Matt Domski, Intern Program Manager

Industrial Water Efficiency Search Tool

Henri Parenteau
Computer Science
University of Minnesota Twin Cities

Organization Background

The Metropolitan Council is the policy-making body, planning agency, and provider of essential services for the Twin Cities metropolitan region. Their mission is to foster efficient and economic growth for a prosperous region. Metropolitan Council Environmental Services (MCES) is tasked with managing water and wastewater within this region, including water supply planning. The Minnesota Technical Assistance Program (MnTAP) is an outreach program focused on preventing pollution and maximizing resource use efficiency in the form of no-cost technical assistance. MCES and MnTAP have been collaborating on industrial water efficiency projects in the metropolitan region since 2012.

"This summer has been a great opportunity to go through the entire development process, starting from research through publication. I was also very lucky to have the the chance to directly apply my skills in data science to sustainability." ~ HP

Project Background

In 2020, Bethany Mestelle analysed MnTAP's database of water related suggestions made during intern projects. She categorized the suggestions according to function:

- **map** - build a water use map of a facility
- **maintain** - return operation to original performance
- **manage** - perform the same operation more efficiently
- **modify** - re-imagine how water is used in a process

This previous work identified specific high value suggestions across many industries. The current project built on the 2020 effort by developing a search tool for the database created in 2020. The goal of this work is to allow users to search the database collection of industry-specific water efficiency recommendations to identify high volume, high value efficiency options for replication in their own facilities. A key feature of this work was to allow public access to the various water efficiency ideas while maintaining confidentiality of the businesses originally receiving the recommendations. The developer was successful in meeting both objectives by researching available data management programs.

Tool Development

The Industrial Water Efficiency Search Tool has been built on the data visualization platform Tableau, a platform which allows developers to build visualizations for users trying to understand relationships within a set of data. The application is especially useful for Tableau because it integrates with Salesforce, a client relationship management system that MnTAP has been using since 2012 to store suggestion data, review past work and track implementation progress.

The Industrial Water Efficiency Search Tool itself consists of a filterable table which displays statistics and details which meet the criteria for this project. This includes the title of each suggestion, savings and cost data, the method of implementation, the industry sector, and a link to the published summary for each project where the suggestions originated.

Filters are included in the navigation pane (see Figure 1) to allow users to search through suggestions for specific information. Search features include searching by:

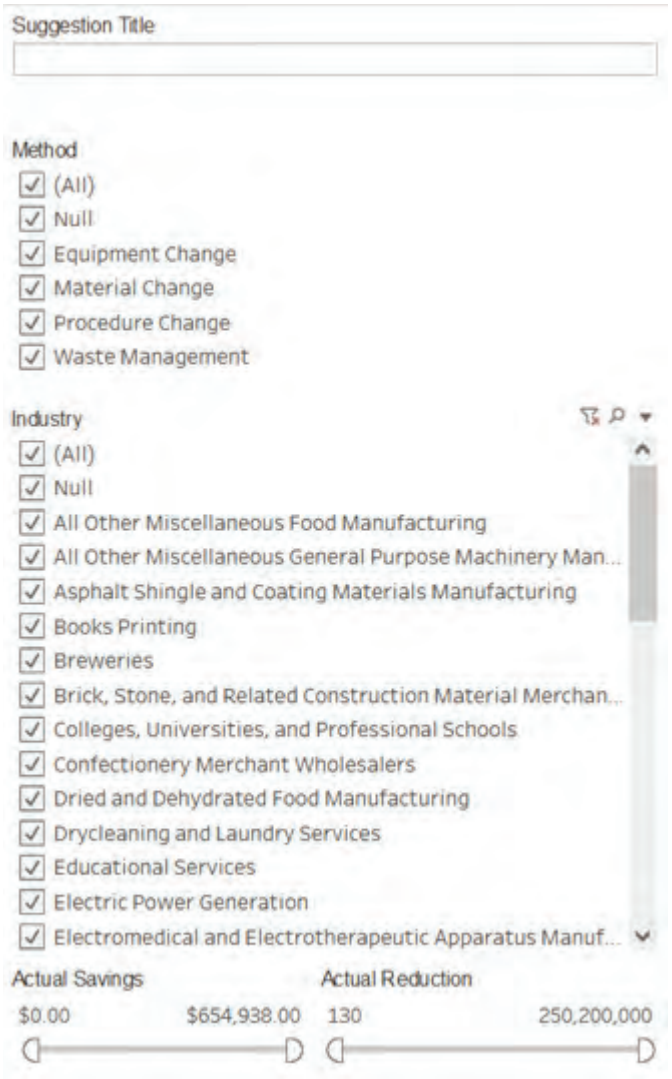
- industry sector
- method of implementation
- key words in a process or function.

Solutions

Each suggestion has a link to a published executive summary that provides more information about the project that generated the water efficiency suggestion. The summaries can provide valuable detail for replication of the idea.

The following figure shows the Industrial Water Efficiency Search Tool Interface.

Figure 1: Industrial Water Efficiency Search Tool Interface



Results

The Industrial Water Efficiency Search Tool provides a new and useful way to search through MnTAP's database of previous suggestions made during intern projects dealing with water efficiency. This data has been chosen to link users with publicly accessible executive summaries as a way to preserve confidential information contained in many of the recommendations for general technical assistance activities. It allows users to filter by industry and retrieve well-defined water efficiency actions that have been suggested and in many cases implemented in an industrial setting. It also improves the accessibility of publicly available MnTAP data, specifically by linking the executive summaries of projects to searchable data on savings in industry categories. This tool can provide an easy-to-use source of information to expand the impact of each MnTAP Intern Project far beyond the company where it was first recommended or implemented. The tool is available at http://www.mntap.umn.edu/resources/tools-calculators/water-tool/.

Next Steps

There is great potential to expand the Industrial Water Efficiency Search Tool. Similar tools could also be developed for other areas for which MnTAP provides technical assistance and makes client recommendations, such as energy conservation and waste management.

MnTAP Advisor: Alaina Ryberg, Web Designer & Information Specialist

JIT Powder Coating Co.

Calvin Harris
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

JIT Powder Coating Company is a custom coater located in Farmington, MN. The company supplies high quality powder coats on a variety of formed and fabricated metal substrates for businesses in Minnesota, Wisconsin, and Iowa.

"I am thankful to have had this awesome opportunity through MnTAP! I was stretched in many different ways, from designing equipment to ordering parts, and I learned so much about the engineering and problem-solving processes. I am confident my recommendations to JIT are worthwhile and that my new skills will apply directly to future occupations." ~ CH

Project Background

Powder coating requires rigorous surface preparation of the parts by either spraying or dipping them in a series of different rinses. This process, known as pretreatment, enhances the corrosion resistance of parts and improves adherence for the powder coating. JIT uses an industry standard chemistry known as iron phosphate for its two pretreatment lines. However, a relatively new zirconium-based chemistry has emerged as an alternative that can provide equal or superior pretreatment quality while offering advantages in costs and phosphorus reduction. JIT saw the MnTAP intern program as an opportunity to drive improvement projects that would allow them to support a potential shift to zirconium, and also evaluate opportunities to save energy and labor.

Incentives To Change

While JIT Powder Coating has always produced quality powder coats, the company continuously looks to improve the quality, consistency, and throughput of its operations. Being able to achieve these goals would help expand the company's business opportunities while saving them money. The company also has strong ties to its neighboring communities and regularly takes initiatives that allow them to be a leader in environmental stewardship and promote a safe workplace for their employees.

SOLUTIONS

Install Small Line Immersion Heater

JIT was struggling with significant down time in their smaller conveyor line due to the need for heat exchanger maintenance. The limited availability of this line meant the larger line was needed for smaller runs impacting scheduling and energy use. A new immersion-style burner was recommended that is anticipated to require less maintenance. Improving the reliability of the small line is anticipated to improve JIT's production capacity while helping to save natural gas. Additional savings are expected from decreased maintenance and replacement parts costs.

Implement Large Line Modifications

There are a number of improvements that JIT can make on the equipment that supports the operation of their large wash line. These upgrades are important steps towards being able to achieve the next level in process and quality control. Four of the five pumps that operate each pretreatment stage can be replaced with newer, right sized models that will be more reliable.

"It is hard to have someone be able to exclusively focus on a single project. But with Calvin, we now had someone dedicated to solving the washer challenges that were preventing us from making our 2nd conveyor line into a fully capable production area. Calvin did great work and we expect to have many of his recommended solutions implemented by the end of 2021."

~ Tim Milner, President, JIT Powder Coating

Solutions

Changing out the manifolds that deliver the chemistries to the nozzles from blackened iron to CPVC will offer advantages of decreased fouling and maintenance costs. Implementing a regular schedule for nozzle maintenance will also help to verify that they are spraying effectively, ensuring a consistent, high quality surface on the parts. Finally, automating chemical additions to the tanks was recommended, which would decrease labor spent on titrating and manual additions and ensure consistency in the tanks. These upgrades will help to boost the reliability and consistency of the large line's pretreatment quality while helping to save resources such as chemical, energy, time, and labor. If all of these changes were to be implemented, the savings from the reduction in costs due to reworks were estimated to be $11,000.

Install VFD on Pumps

It is recommended that the new pumps are also equipped with variable frequency drives (VFDs). This will allow the flow rates through each of the stages to be easily adjusted according to production requirements while being more energy efficient than using a throttle valve.

Use Zirconium Pretreatment

There is an opportunity to transition to a zirconium pretreatment chemistry on the large wash line. The chemistry has the advantages of being applied at ambient temperatures and producing low amounts of sludge. Because the process tanks do not need to be heated, JIT can save $17,700 from reduced natural gas usage. An additional advantage is that there is less phosphate released into the outgoing wastewater.

Install VFD on Exhaust Fan

The current exhaust fan on the large line is oversized and cannot be operated because it removes too much of the spray in the first stage. Another challenge is the fan's tendency to freeze over during the winter due to the high humidity inside the building. Installing a VFD on the fan would allow JIT to decrease the speed of the fan to a level where it can be effective without interfering with the pretreatment process. They would also be able to run the fan with automatic shutdown settings that would prevent the fan from freezing in the winter. This will help to improve the climate and comfortability of workers within the building throughout all months of the year.

Recommendation	Annual Reduction	Annual Savings	Status
Install Small Line Immersion Heater	95,600 therms	$33,000	Planned
Large Line Modifications (CPVC Manifests, New Pumps, Automation, Nozzle SOP)	Natural gas from paint burn off (fewer parts needing rework)	$11,000	Planned
Install VFD on Pumps	34,400 kWh	$4,000	Planned
Use Zirconium Pretreatment Chemistry	51,000 therms	$17,700	Recommended
Install VFD on Exhaust Fan	NA	NA	Recommended

MnTAP Advisor: Daniel Chang, Associate Engineer

Living Greens Farm

Luiza Rabelo
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

Living Greens Farm was founded in 2012 by Dana Anderson, who wished to develop a commercial facility with aeroponics technology, in which crops are grown in vertical stacks without the use of soil. This technology uses 95% less water and 99% less land than conventional agriculture methods, and allows harvest to occur all year round, even during the harsh Midwestern winter. The 42,200 ft2 facility, located in Faribault, MN, now employs 48 people and produces a variety of ready-to-eat lettuce, salad kits and microgreens.

"During the summer in Living Greens Farm, I learned a lot about many interesting processes I didn't even know existed. It was also a great way to gain experience I'll need for my career in the future." ~LR

Project Background

Living Greens Farm's facility in Faribault, MN, uses roughly 4.5 million gallons of water per year. The water is used for irrigation, cleaning and domestic purposes. As the company works on expanding by opening a new facility, it was interested in a detailed overview of its water usage, as well as in possibilities for reducing any needless waste. As such, the project consisted of two parts: mapping and identifying water intensive processes in the facility and recommending and implementing water reduction strategies. Goals of the project also included improving the facility's energy efficiency.

"Our experience with the MnTAP Program was great as our intern made recommendations for our compressed air, water and building lighting that will have an estimated annual cost savings of $12,000 per year. The knowledge gained from these recommendations will have a significant impact on our expansion projects over the next two years. We appreciate the level of professionalism, curiosity, and productivity our Intern, Luiza, brought each day. We were fortunate to have her on the team over the summer.

~ Ken Sourbeck, Vice President and General Manager

Incentives To Change

In addition to continually seeking cost-saving measures, Living Greens Farm (LGF) is a company that prides itself in the environmentally conscious approach offered by its aeroponics technology, and is always looking for ways to reduce its impact. The company is also in the process of constructing a larger facility in the Upper Midwest. Identifying strategies that save water and energy at the Faribault location will be amplified within the new location, due to its greater size.

SOLUTIONS

Replace Nozzle Tips in Processing Room

Hoses in the facility's processing room, which are frequently used for long cleaning processes, had nozzles of 10 gpm. By exchanging the nozzle tips from standard to low flow, the flow rate was changed to 7 gpm. This change will save 170,000 gpy.

Fix Compressed Air Leaks

A compressed air leak audit was conducted with an ultrasonic leak detector, and various leaks were found throughout the facility. One was identified to be due to a broken piece of equipment, for which a replacement valve was ordered. All others are currently being fixed by the company's maintenance team. In total, fixing the air leaks will save 127,000 kWh a year.

Solutions

Install Lower flow Aerators

The employees at the Living Greens Farm are required to wash their hands frequently, prior to entering the facility's internal rooms. Currently, the handwashing sink stations outside the processing room and grow rooms have 1.5 gpm flow aerators. The aerators in the bathroom sinks are 1.2 gpm, as is the sink in the breakroom. It is recommended that the faucets in the handwashing stations and bathrooms be replaced with 0.5 gpm aerators.

Reuse Condensate from Air Handlers

As the global water crisis worsens and droughts become more frequent, many companies have taken to reclaiming and reusing air conditioning condensate for non-potable purposes. At Living Greens Farm, condensate from three air handlers is currently being sent to the drain. A simple rerouting of the system's piping could allow the condensate to be sent to the facility's pre-RO city water tank. This would save approximately 350,000 gallons of water per year.

Install LED Lights

The facility had recently changed most of its lights to LED lights. However, some metal halide and fluorescent bulbs were still present. It is recommended that those be changed to low wattage LEDs, which would save 18,000 kWh annually. The facility's current LEDs also have lower wattage alternatives, and it is recommended that the company consider them in future lighting projects.

Recommendation	Annual Reduction	Annual Savings	Status
Replace nozzle tips in Processing Room	170,000 gal water	$1,140	Implemented
Fix Compressed Air Leaks	127,000 kWh	$11,500	Mostly Implemented
Reuse Air Handlers Condensate	350,000 gal water	$2,400	Recommended
Change to LED Lights	13,000 kWh	$1,200	Recommended
Install Lower Flow Aerators	51,600 gal water	$340	Recommended
Switch from Hoses to Squeegees for Cleanup	21,800 gal water	$350	Not planned

MnTAP Advisor: Jon Vanyo, Engineer

Miller Manufacturing

Anna Walsweer
Mechanical Engineering
University of Minnesota Twin Cities

Organization Background

Miller Manufacturing is a farm, ranch, and pet product injection molding facility in Anoka, MN that is owned by the family-owned Frandsen Corporation. This facility is 185,000 square feet and employs 220 people. Brands under Miller are Little Giant, Hot Shot, Pet Lodge, API, Springer Magrath, and Double-Tuf.

"This summer I had the opportunity to gain hands-on experience working in a real-world manufacturing environment. I was challenged with complex problems to solve and given the autonomy and support to develop solutions that will help Miller Manufacturing and the environment. This experience helped me become a more well-rounded student and soon-to-be graduate. I'm grateful for the opportunity MnTAP made possible and loved my time at Miller Manufacturing." ~ AW

Project Background

On an annual basis, Miller Manufacturing produces 315 tons of solid waste costing $48,600 for disposal, and spends $78,000/yr on electricity. The purpose of this project is to reduce waste and electricity use by refining their waste management practices and operating procedures.

Incentives To Change

Miller Manufacturing is committed to reducing waste and energy use. This will allow for Miller to improve their working environment, reduce their environmental impact and save money. Frandsen Corporation believes success is the result of employee efforts and behaviors. The Frandsen Way is 26 fundamentals that define their company culture. Fundamental 18 is "Do the Right Thing Always". This is something that Miller Manufacturing believes in day in and day out. Miller's green initiatives make it a priority to consider the environment and natural resources in the manufacturing of their products

SOLUTIONS

Increase Recycling

Used cardboard can be bailed and sold for $160/ton, but the waste sort indicated over 20,000 lbs/yr is still ending up in the trash. Cardboard gaylords which can be sold for at least $6 each are also sometimes put in the trash instead. By keeping this cardboard out of the trash Miller can earn $1,600 as well as avoid $1,000 in disposal costs. Implementing a single stream recycling system will keep an additional 10,300 lbs of bottles, cans, and paper out of the landfill, and a grant from Anoka County will cover the cost of the necessary bins.

Cardboard Sheet Replacement

Two almost identical cardboard sheets were found in inventory; one was 1% smaller, but less than half the cost. Switching to the smaller option provided annual savings of $9,000 and 620 lb reduction in cardboard usage with no cost or impact on operations.

Reusable Shipping Containers

Some products molded at Miller's Anoka facility go on for further processing in house or at their facility in Glencoe, MN. Currently these products are palletized with cardboard and shrink wrap until they are ready for the

Solutions

next step. Reusable shipping containers would eliminate the consumption of cardboard sheets and shrink-wrap. The upfront cost of about $250-$400 per container can be offset by grant funding and over $23,500 in packaging savings.

Linerless Labels

Linerless labels are available that have a release coating on the front of each label allowing them to be rolled directly on to each other (like tape), eliminating the need for backing. These labels are available both pre-printed and for applications that must be printed at time of use. Linerless labels would eliminate 4,680 lbs/yr of liner waste and improve plant safety by eliminating a potential slip and trip hazard.

Regrind Reclamation

The waste sort found that 53% of the waste was plastic that could potentially be reground and reused, including excess and off spec parts, sprue from the molding process, and leftover resin pellets. Reusing this material would not only reduce waste disposal costs by $9,000 per year, but also save $200,000 annually on resin purchases. One step Miller has already taken is dedicating a grinder for polycarbonate, which was previously not available. Miller continues to investigate ways to better manage their raw material and regrind processes.

Energy Projects

Energy projects were addressed by utilizing lighting and compressed air professionals. New LED lights, with motion sensors in lower traffic areas, will reduce electric costs by 50% annually, increase lumens by 20%, and be completely deductible through the CARES Act. A compressed air audit identified savings of $8,300 and 94,500 kWh/yr, with a payback of less than four months after rebates.

"The Frandsen Corporation has used MnTAP in the past and had good results. Bringing on Anna for the summer continued that trend. MnTAP has a solid process and they listened to where we thought the areas of the greatest needs were. Anna was very much a self-starter and some of the results were achieved in a very short period of time. Overall we were pleased with the reductions of waste and energy usage"

~ Dave Dickirson, General Manager
Miller Manufacturing

Recommendation	Annual Reduction	Annual Savings	Status
Increase Recycling	30,300 lbs.	$2,500	Recommended
Cardboard Sheet Replacement	620 lbs.	$9,000	Implementing
Reusable Shipping Containers	16,500 lbs.	$23,500	Investigating
Linerless Labels	4,680 lbs.	$240	Investigating
Regrind Reclamation	171,000 lbs.	$205,000	Parially Implemented
Energy Projects	559,000 kWh	$63,000	Implementing

MnTAP Advisor: Jane Paulson, Senior Engineer

MnTAP Industrial Chloride Project

Sidharth Laxminarayan
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

The Minnesota Pollution Control Agency (MPCA) is committed to ensuring every Minnesotan has healthy air, sustainable lands, clean water and a better climate. MPCA works with the Minnesota Technical Assistance Program (MnTAP), an outreach program in the School of Public Health at the University of Minnesota. This partnership provides pollution prevention technical assistance to businesses and organizations around the state to reduce pollution at its source to improve public health and the environment.

MINNESOTA POLLUTION CONTROL AGENCY

"This summer I had the opportunity to explore water treatment operations, water softeners in particular, and work on optimizing them to reduce chloride effluent. This allowed me to be an environmentally conscious engineer and gave me the tools and skills to do research in areas where I have a significant knowledge gap." ~ SL

Project Background

This project sought to develop Best Management Practices (BMPs) to reduce chloride discharge in industrial wastewater effluent from water softeners. This work compiled a list of BMPs and created a flowchart for operations that should be considered during a water softener audit (Figure 1). These BMPs and audit strategies were tested during site visits at five facilities with a goal of making recommendations to companies to implement the BMPs.

Incentives To Change

Chloride is toxic to aquatic life which is concerning given the widespread use of chloride salt in residential, commercial, and industrial settings. Even small amounts of chloride have the potential to pollute large amounts of water, with 1 teaspoon of salt enough to pollute 5 gallons of water. In 2020, there were 50 bodies of water in Minnesota listed as impaired due to chloride, 40 of these are in the seven-country Twin Cities Metropolitan Area. It is important that chloride discharge is reduced to preserve the health of our aquatic environments. While there are treatment options available for removing chloride from wastewater effluent, these options are not economically feasible. Optimizing water softeners ensures that salt is used efficiently, thereby reducing the amount of chloride discharged.

SOLUTIONS

Use Accurate Hardness Setting

Softeners may have the feed water hardness set higher than the actual hardness of the raw incoming water. Setting the feed water hardness to reflect the hardness of the incoming raw water leads to instantaneous water and salt savings. Accurately setting the water hardness has the potential to increase the capacity of the softener, thereby reducing the number of regenerations performed by the softener and in turn reducing salt and water use. This is a programming change with no implementation cost.

Lower Salt Dosage

Salt dosage refers to the amount of salt used per cubic foot of resin during regeneration. Decreasing the salt dosage allows the softener to operate at a higher salt efficiency. Increasing the softener efficiency allows the softener to use less salt to remove the same amount of hardness. Increasing the efficiency to a minimum of 4,000 grains/lb at a minimum salt dosage of 5 lbs/ft^3 is recommended. This change results in instant salt savings, but will increase water use due to the increase in regenerations. This is a programming change with no implementation cost but has the potential to significantly reduce the chloride discharge from the softener.

Solutions

Replace the Resin Bed

Water softeners experience 1-3% resin bed volume loss annually due to the force of the backwash during regeneration or foulant accumulation. When compounded across 10 years this translates to at 10-27% decrease from the original bed volume. The resin loss reduces its overall softening capacity which increases the number of regenerations, increases chloride effluent and accelerates the rate of resin loss. Manufacturers recommend replacing the resin bed every 10 years which restores the original unit capacity and allows the system to operate efficiently.

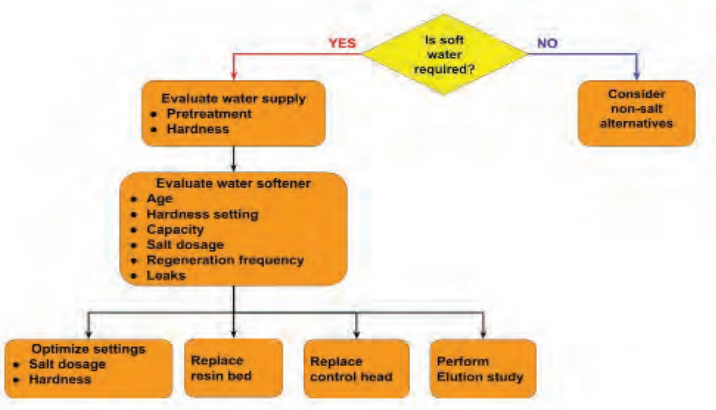
Conduct an Elution Study

An elution study is a diagnostic tool to determine any problems with the regeneration cycle. An elution study is recommended to analyze the regeneration process and guide optimization actions.

The water softener audit map, procedures and data collection tools can be found on the MnTAP website.

www.mntap.umn.edu/resources/tools-calculators

Figure 1: Water Softener Audit Process Steps



"Working with the MnTAP internship program has been such a wonderful experience. This valuable work has not only recommended ways to reduce chloride entering Minnesota's water resources from the facilities the intern worked with, but provided a process that many more facilities can learn and benefit from. It has also provided partners working toward chloride reduction with insights into how to help more facilities and businesses reduce chloride from water softening systems across the state. I look forward to a continued partnership with the MnTAP program to address the challenge of reducing chloride pollution at the source."

~ Brooke Asleson,
Chloride Program Administrator at MPCA

Company	Recommendation	Annual Reduction	Annual Savings	Status
A	Change Salt Dosage and Hardness Settings	Salt: 90,000 lbs Water: 252,000 gal	$12,000	Recommended
B	Change Salt Dosage and Hardness Settings	Salt: 13,000 lbs Water: 10,500 gal	$1,200	Recommended
C	Change Salt Dosage setting	Salt: 29,000 lbs Water: 41,700 gal	$2,800	Recommended

MnTAP Advisor: Laura Sevcik, Pollution Prevention Specialist & Laura Babcock, MnTAP Director

MnTAP Intern Program SOP

Mia Clark
Political Science
University of Minnesota Twin Cities

Organization Background

The Minnesota Technical Assistance Program (MnTAP) is a grant-funded outreach program based in the School of Public Health, Division of Environmental Health Sciences at the University of Minnesota. Through industry-tailored, site-specific technical assistance, MnTAP seeks to help companies and organizations across a wide range of industries in the state of Minnesota. The primary objective of MnTAP's assistance is to optimize processes while saving water, energy, raw materials and preventing waste and pollution. MnTAP staff are trained to work with facilities to develop cost-effective solutions that achieve the aforementioned environmental goals. These types of solutions help MN businesses and organizations reach their sustainability goals while remaining competitive in their respective industries. The crossroad of environmental and economic value is at the core of MnTAP's mission.

"Working as a MnTAP intern provided me with an enriching summer work experience that taught me an immense amount about management, working independently, and about everything that goes into creating such an incredible program. I am very thankful for this experience." ~ MC

Project Background

MnTAP's intern program is one if its key assets, which involves the development and execution of 15-20 three-month intern projects at host facilities in Minnesota each summer. The projects provide a fantastic growth and training opportunity for students, as well as dedicated science & engineering expertise to host businesses at a tremendous value.

To maintain a successful intern program, a great deal of coordination, planning, recruiting, partnership development and more is required. As an organization committed to continuous improvement, MnTAP was interested in refining its own program management procedure, as well as developing a consolidated guide for external organizations to use that have interest in launching their own programs.

Standard Operating Procedure—Project Goals

Internal Guide Refinement

Refining the MnTAP Intern Program Standard Operating Procedure (SOP) will allow for better consistency during each phase of the program and effective replication of those phases each year. Improving on the structure and format of the SOP will help current staff better-plan for objectives, which can save time and effort for those involved. A refined SOP can help ease transitions as MnTAP staff resources changes over time.

General Guide Creation

The second objective in refining the Intern Program SOP is to produce a version that can be shared with organizations across the country who wish to launch intern programs at their own institutions. MnTAP has been fortunate to collaborate with a number of technical assistance programs in other states. Some of these partners have well-established intern programs, but there are others who are just getting started. With an external version of its SOP, MnTAP hopes to provide an example that highlights some of the key facets and objectives to running a successful P2 intern program.

Final Outputs

MnTAP-Specific Intern Program Standard Operating Procedure (SOP) Guide

Past and present intern program resources were analyzed and re-organized into a comprehensive guide for use by MnTAP. The new, MnTAP-specific SOP arranges intern program management into 4 phases:

- Focused Recruiting: partners, companies and interns
- Scope, Select and Finalize Projects
- Execute Program: training, site work, symposium
- Report and Showcase Results

This procedure details elements of the program that are specific to MnTAP, which pertain to funding, hiring, recruiting resources, project agreements and more. These elements are crucial in replicating the program each year and the new guide organizes them in an improved structure.

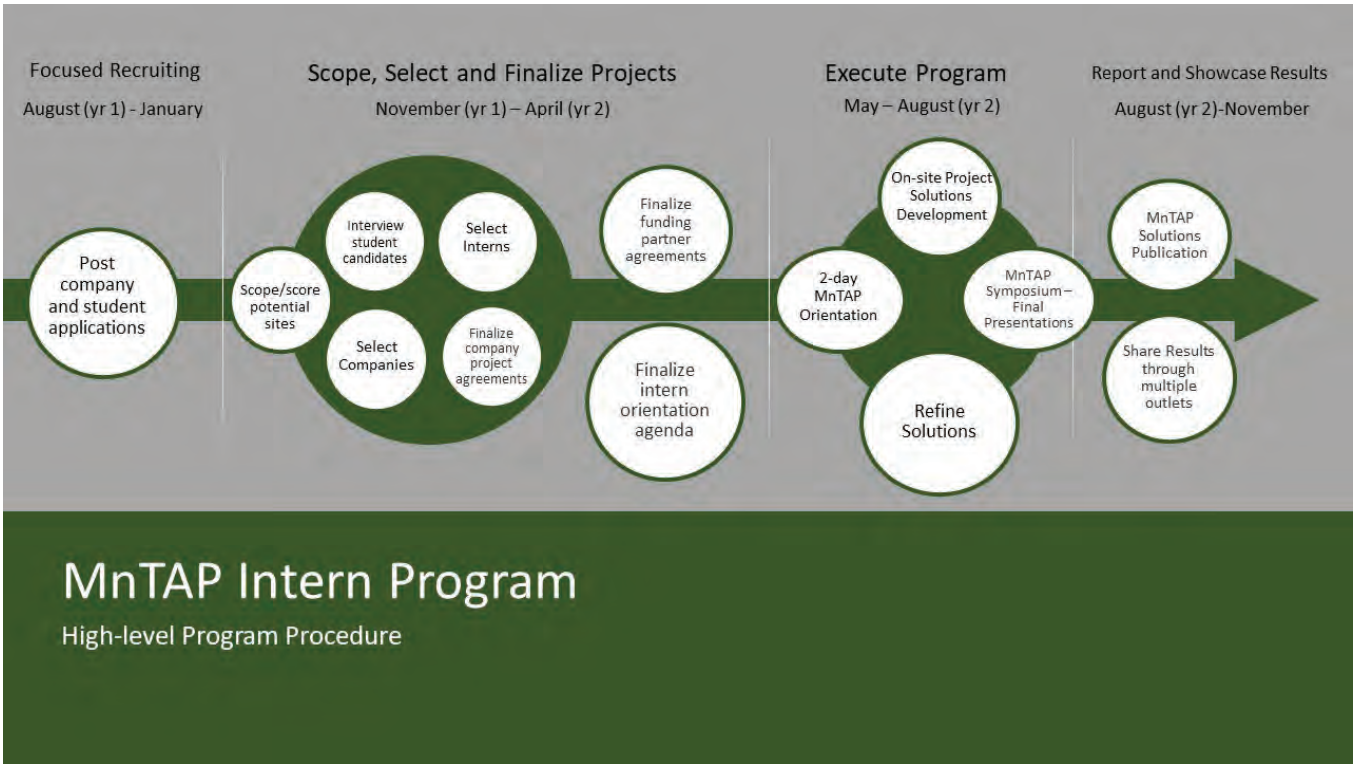
The MnTAP Intern SOP guide utilizes timeline summaries for a broader look at what needs to be accomplished during each phase. In addition, the guide is structured to work with the Microsoft Word section navigation feature, allowing user to jump to the appropriate phase section without searching the entire guide.

Intern Program SOP Guide for External Organizations

In an effort to provide guidance for organizations interested in launching or improving their own intern programs, the MnTAP-specific guide was refined to highlight key activities that drive a successful intern program.

The external intern SOP guide follows the same phase structure as the internal guide. The key difference between the guides is that the external version is absent of MnTAP-specific forms, contacts and partners that would be irrelevant to external readers. Though this information has been removed, some examples have been included to accompany the phases, which provide inspiration to programs that may be starting from scratch.

Figure 1: MnTAP Intern Program Process Stages



MnTAP Advisor: Matt Domski, Intern Program Manager

National Sports Center

Niklas Martensson
Environmental Science
University of St. Thomas

Organization Background

The National Sports Center (NSC) in Blaine, MN is the world's largest amateur sports facility. It is home to 50 multi-use soccer fields, eight ice rinks, an 18-hole golf course, a stadium field, a sports exhibition facility, an indoor turf field, a 180-bed residence hall, and the Minnesota United soccer team's practice field. On any given day, there is an average of 12 different programs in progress and they receive over 4,000,000 visitors in a typical year.

"I am very happy to have had the opportunity to combine my two passions in my work with the National Sports Center and MnTAP: sports and sustainability. Through my experience, I have learned that this is a growing field and is taken seriously by many sports teams and venues in accordance with sustainability goals." ~ NM

Project Background

Given the NSC's size, two areas were focused on this summer: the Super Rink and Victory Links Golf Course.

The Super Rink, which houses the eight ice rinks, uses over seven million gallons of water annually. Half of the water is softened then heated before being used to resurface the ice rinks or wash down the ice resurfacers. Water used in resurfacing drains into a melt pit and is sent to sewer.

The golf course uses an average of 46,000,000 gallons of water per year for irrigation. Storm water from the campus parking lots drains into a retention pond, which feeds the irrigation system for the golf course. Makeup water comes from a well on site.

Incentives To Change

As a non-profit, the NSC is constantly considering how it can benefit the community. Reducing water and energy has the dual benefits of improving Minnesota's environment and saving money. Staff have set the ambitious goal of becoming a net zero facility and already have a 10 MW solar initiative. By hosting a MnTAP intern, they hoped to further reduce their consumption.

SOLUTIONS

Melt Pit Water Recycling

Installation of a recycling system for the melt pit water would dramatically reduce the impact and consumption of the ice rinks. The snow dropped into the melt pit would be filtered, de-aerated, and stored before being reused. Approximately, 10,000 gallons of make-up water would be required for each system per year, a

"Niklas was an excellent asset to our National Sports Center team. His enthusiasm and ability to cater to the unique needs of our operation left us impressed and eager to implement his recommendations. We look forward to seeing real time results and building upon the foundation he laid."

~ Karah Lodge, Associate Director, National Sports Center

Solutions

reduction of 99%. Additionally, because of the de-aeration, water would not need to be heated, which would save natural gas, decrease load on the refrigeration system, and allow for a possible elevation in brine temperature.

Because installing the recycling systems will take extensive planning, two additional solutions were recommended to conserve water in the interim.

Ice Resurfacer Operations Plumbing Retrofit

Both the refilling and washing down of the ice resurfacers are currently done by hand. Automating refilling with a timer will eliminate tank overfilling. Providing a separate high-pressure low-flow hose for washdown will retain the efficacy of the cleaning process while reducing water. These opportunities were combined into one plumbing retrofit that could be easily installed on the facility's hot water lines.

Integrated Auger Washout

An integrated auger washout system would automate the washdown process by channeling water remaining in the resurfacing tank after ice resurfacing over the ice resurfacer mechanisms. This automated cleaning device would be installed on the rear of the ice resurfacer machines to remove the snow that builds up underneath the ice resurfacer.

Victory Links Golf Course Sprinkler Head Conversion

Adjustments to the current irrigation patterns on Victory Links Golf Course could be made to reduce unnecessary watering. Currently, each sprinkler head has a 360° arc. Twenty percent of the sprinklers are located near fringe areas and pathways and could be reduced to a 210° arc. This would simultaneously preserve the quality of the course and annually conserve three to eight million gallons of water depending on rainfall.

Recommendation	Annual Reduction	Annual Savings	Status
Melt Pit Water Recycling	4,360,000 gal of water 57,200 lbs. of salt 36,400 therms of natural gas 620,000 kWh	$80,800	Recommended
Ice Resurfacer Operations Plumbing Retrofit*	890,000 gallons 10,800 lbs. salt 7,400 therms	$9,200	Planned
Zamboni Integrated Auger Washout*	824,000 gallons 8,700 lbs. salt 6,900 therms	$8,400	Recommended
Sprinkler Head Conversion on Victory Links Golf Course	5,800,000 gallons 34,000 kWh	$2,300	Recommended

*The annual reduction and savings for these recommendations are not additive. The maximum amount of savings is equal to the melt pit water recycling recommendations combined.

MnTAP Advisor: Gabriella Martin, Associate Engineer & Brent Vizanko, Associate Engineer

Northrop Grumman

Audrey Frederick
Biomedical Engineering
University of Minnesota Twin Cities

Company Background

Northrop Grumman is a leading technology provider for the United States and their allies with sectors in aeronautics, space, and defense, and mission systems. The Elk River location has about 65 employees and is a part of the defense systems sector. Elk River is a primary location for armament development, assembly and testing, and is the nation's largest privately owned proving grounds.

"Working with Northrop Grumman was a very rewarding experience as many people on site were excited about the project and were eager to help along the way. This program was a great opportunity to apply the engineering approach to the real world and to see how driving for sustainability can have a huge impact."~ AF

Project Background

Northrop Grumman's corporate headquarters has been emphasizing sustainability in recent years. By 2020, Northrop Grumman sought to reduce their greenhouse gas emissions by 30% and divert 70% of their solid waste. As of 2020, the greenhouse gas emissions were reduced by 43% and the solid waste diverted at a rate of 69%. With new goals for 2030 on the way, Northrop Grumman was interested in waste and greenhouse gas emissions reduction projects with MnTAP to further reduce their impact on the environment.

Solid waste reduction and energy efficiency opportunities have been explored. An area of potential waste reduction had been previously identified in the ammunition soft catch testing area. This process area requires significant manpower to conduct testing and follow up retrieval of projectiles. It generates a large amount of solid waste and is increasing in cost due to raw material supply limits. Numerous alternatives have been considered in the past, however, none of these options met all the process needs. Turning to energy use, both a lighting audit and a compressed air assessment were conducted to determine if there were additional opportunities to capture.

Incentives To Change

The primary motivations in pursuing this intern project were to reduce waste and greenhouse gas emissions. Northrop Grumman set substantial companywide sustainability goals and felt the Elk River site had large opportunity due to the size and age of the facilities as well as the increasing demand for ammunition testing. Northrop Grumman welcomed any additional benefits arising from this work such as an operating cost reduction and improved safety for hazardous operations.

SOLUTIONS

Reusable Target Materials

An area of potential waste reduction was identified in the ammunition testing area. Currently, target material is used to catch the projectiles from the tests for further analysis. This process currently utilizes large bundles of fiberboard sheet to safely catch the projectiles and a significant amount of manpower is required retrieve them after each

Solutions

test. Along with producing nearly 340,000 lbs of solid waste annually, the current testing process has increased in price over the years. It is recommended to replace fiberboard target material with industrial sized bags of crumb rubber for this testing area. This process change would also implement a material handling device to retrieve the projectiles as well as collect and reuse the crumb rubber material for future testing. This solution could save Northrop Grumman $154,000 while eliminating 340,000 lbs of solid waste annually.

Update Lighting Fixtures

Energy efficiency projects such as LED lighting retrofits have been launched successfully in the past. There were several additional lighting opportunities identified over the course of this work. A lighting audit was performed in 10 building areas to assess the type of lighting in place and the quality of light delivered to the respective work areas. By updating the light fixtures, Northrop Grumman has the potential to save 57,000 kWh and $9,000 annually while the quality of lighting for work tasks will improve.

Optimize Compressed Air Systems

Compressed air systems can be one of the most expensive power sources in many manufacturing buildings. Installing smaller air compressors for HVAC control in explosive operations buildings and following best practices allows for the larger compressed air system to be turned off after operating hours and optimizes the compressed air system. This could save Northrop Grumman 131,000 kWh and $20,600 annually with additional benefits of less emergency maintenance on compressed air systems.

Recommendation	Annual Reduction	Annual Savings	Status
Rubber Mulch Target Material	340,000 lbs	$154,000	Recommended
LED Lighting Retrofit	57,000 kWh	$9,000	In Progress
Updating Air Compressor Systems	131,000 kWh	$20,600	Recommended

MnTAP Advisor: Michelle Gage, Engineer

Rochester Meat Co.

Claire Schleusner
Chemical Engineering
University of Minnesota Twin Cities

Organization Background

Rochester Meat Company was founded in 1971 in Rochester, MN, and produces frozen beef patties and other beef products. For decades they maintained high levels of work ethic and innovation, as demonstrated by the creation of the Cloud burger. In 2007 they merged with Holten Meats to become Branding Iron Holdings, and since then they have continued to operate under the Branding Iron label.

"This internship was an amazing experience that really helped me grow my practical engineering skills. Every part of this program helped me grow as an engineer while also allowing me to make a real difference." ~ CS

Project Background

Rochester Meat Company applied to the MnTAP internship program to help address high readings in their recent wastewater samples. Due to the nature of the facility, the wastewater contained high levels of total suspended solids (TSS) and biochemical oxygen demand (BOD). The company wanted to decrease these wastewater levels as well as reduce their water and energy consumption.

Incentives To Change

The wastewater generated from the facility's production and sanitation processes has high levels of TSS and BOD. These parameters are costly for the downstream POTW to treat and are passed back to the facility in their wastewater fees. The high strength charges were unsustainable for Rochester Meats in the long term, and meant that any decreases in both water consumption and wastewater loading would have significant impact on their bottom line. The facility also continually strives to implement best practices that can improve their water and energy usage efficiency.

SOLUTIONS

Implement Dry Cleaning Process

The intern spent several days at the facility during the third shift to observe sanitation activities. From these visits, it became clear that procedures and utilization of wastewater controls were not fully established. Drains with strainers meant to catch product were often removed and product would be washed off of machines to the drains instead of being placed into disposal containers. These practices lead to high strength wastewater liable to surcharges. The intern initiated discussions with the sanitation manager and employees to reiterate sanitation procedures and clarify expectations. The intern also created signage around the facility to remind workers of the procedures as well as training materials in the form of a presentation for the company to incorporate into its employee orientation. Establishing a goal of diverting 50 lbs of meat from the sewer daily would result in 15,000 lbs of meat diverted from the sewer and an annual savings of $13,500.

"Over the course of the summer, Claire was able to focus on several areas of the operation that typically do not receive much attention. By asking the right questions and doing the research, she was able to develop quite a few cost-saving ideas with substantial ROI. Overall, our experience with MnTAP was extremely positive!"

- Dave Lee, Plant Manager & Mike Week, Assistant Plant Manager

Solutions

Install Recirculating Water Chillers

Six different machines were found to be cooled using single pass cooling water, which ran through the machines continually. After researching several possible solutions, including reuse opportunities, the intern found an affordable recirculating cooler that could be installed on each of the machines. Installing this equipment would eliminate any further water use by recycling and chilling the outlet water. Implementing this change can save 2.9 million gallons of water and $13,400 annually.

Replace Metal Halide Lights with LEDs

The company was aware that there was an opportunity to upgrade its lighting and tasked the intern with completing a lighting audit. Metal halide light fixtures were used in the freezer areas; replacement with LED lights had several advantages. The metal halide lights took several minutes to reach their full lumen output and used a high amount of energy. Furthermore, these older style lights generated heat, which increased the refrigeration load needed to keep these areas cold. Switching to LEDs offered the benefits of lower energy costs, immediate full-lumen output when turned on, and minimal heat generation. The intern also provided the facility with recommended LED bulbs for the main production building. Total reduction in energy use is 246,000 kWh, with an annual savings of $24,600.

Fix Compressed Air Leaks

Air leaks are a common occurrence in facilities that utilize compressed air. The intern carried out a compressed air leak using an ultrasonic leak detector to identify and prioritize leaks in the facility. The total savings were 18,000 kWh and $1,800 annually.

Fix Production Area Door Gaps

From continuous time spent walking through the facility and brainstorming ideas, the intern noticed an insulation opportunity to achieve energy savings. Numerous doors separating the colder freezer and production areas from the rest of the facility were observed to have gaps that caused significant loss of cold air. This meant that the HVAC and refrigeration systems in the production areas were consuming more energy to generate additional makeup air. By utilizing a FLIR infrared camera and an anemometer to measure temperature differences and air speeds, the intern was able to estimate the amount of additional cooling that was required and how much could be saved. Fixing the gaps in the doors to maintain a seal in the cold areas could help save 101,000 kWh of energy and $10,100 in annual savings based on a 50% reduction in cold air loss.

Recommendation	Annual Reduction	Annual Savings	Status
Implement Dry Cleaning Process	15,000 lbs meat	$13,500	Planned
Install Recirculating Water Chillers	2,900,000 gallons	$13,400	Recommended
Replace Metal Halide Lights with LEDS	246,000 kWh	$24,600	Planned
Fix Compressed Air Leaks	18,000 kWh	$1,800	Implemented
Fix Production Area Door Gaps	101,000 kWh	$10,100	Recommended

MnTAP Advisor: Daniel Chang, Associate Engineer

South-Town Refrigeration

Julian Kern Steffen
Mechanical Engineering
University of Wisconsin-Madison

Company Background

South-Town Refrigeration and Mechanical engineers install and service commercial and industrial refrigeration throughout Minnesota. Operating since 1954, they are the largest company of their industry in the area. In addition to refrigeration, South-Town designs heating, cooling, building automation, custom ductwork and energy saving solutions for their clients.

"MnTAP is an incredible program that brings together people with a deep passion for the planet and inspires innovation and environmental stewardship. I'm very thankful for the opportunity to learn hands-on, while knowing that my work will make a difference." ~ JKS

Project Background

Grocery stores consume far more energy than other businesses of comparable square-footage and a big reason for that is their walls are lined with refrigerated cases operating constantly. In addition, the refrigerants used in these systems are usually potent greenhouse gases. Grocery store owner/operators often lack the refrigeration expertise necessary to maximize their energy efficiency and recognize or prevent leaks.

The goal of this project is to provide grocery store owners with a comprehensive guide to operating their refrigeration system as efficiently as possible, focusing on practices with little or no capital cost.

Incentives To Change

Fifty-eight percent of the electricity consumed by grocery stores is accounted for by refrigeration, which is a significant impact on their bottom line. EPA estimates a typical grocery store may lose as much as 25% of the refrigerant in their system each year due to leaks. As harmful refrigerants are phased out to reduce global warming, it becomes more expensive or even impossible to refill what is lost. Store owner/operators care about their energy bills and environmental impact, and are interested in implementing efficient solutions that will save them money. In addition, the reliability and security of a refrigeration system is important as refrigeration failure can result in loss of product and major disruption to the business.

SOLUTIONS

Best Practices Guide

A comprehensive guide to general refrigeration system operation and maintenance was drafted. Written in approachable language, the guide details how to identify a myriad of equipment issues. It offers instructions that grocery store staff can follow for basic maintenance and inspections, and allows owner/operators to recognize and request service sooner for issues that require technician servicing. Implementing these practices will help grocery store owner/operators to improve their systems energy efficiency at the cost of a small amount of time per month. The guide can be found at www.mntap.umn.edu/resources/tools-calculators

Condenser Cleaning

Air cooled condensers are typically mounted on the roof of a grocery store and reject heat from hot refrigerant

"The MnTAP internship program provided South-Town Refrigeration & Mechanical with information to support all small and local retailers across Minnesota in maintaining and operating their refrigeration systems. This program is a great step towards improving refrigeration efficiency across the state"
~ Ryan Welty, President
South-Town Refrigeration & Mechanical

by blowing air across a network of tubing. The intake of the unit must be cleared regularly, or dust and debris will quickly accumulate, reducing airflow and efficiency. Many medium to small grocery stores do not go up to the roof to check this on a regular basis. Therefore, it is recommended to clean the coils monthly and document this on the best practices checklist.

Insulation Repair

When refrigerant in transfer piping absorbs heat from the surroundings, it adds load to the system and increases energy usage. Two refrigeration assessments identified areas where missing or degraded pipe insulation was decreasing system efficiency. In one case, an initial quote of $18,000 to repair 1,200 ft of insulation was out of the budget, but the necessary repairs could be made in-house for $4,800 in materials and about 100 hours labor; a total cost of $6,300. IR temperature readings and 3E Plus® software were utilized to estimate the energy savings at 38,500 kWh and $3,400/yr, for a payback time of 1.8 years. A second assessment identified 30 feet of degraded outdoor insulation, which requires PVC jacketing to protect it from rapid UV degradation at an extra $2/ft. The cost for materials and labor was estimated at $300, with an expected savings of $100 and 1,200 kWh/yr.

Awning & Spray Mister

Two condensing units were found mounted too close to the outside wall to maintain proper airflow, but moving them was cost prohibitive. Instead, the cooling capacity of the air around them was increased to improve performance. An awning was constructed to shade the units, lowering the air temperature, and a hose with small misting nozzles was installed above the unit to increase the moisture and heat capacity of the air.

Case Loading

Open air refrigerated product cases use an air curtain to keep cold air inside the case. When product blocks the intake, the airflow pattern is disrupted and the insulation and efficiency of the case are compromised. The estimated annual cost of incorrectly loading a case is 520 kWh and $46 per foot of case. During one walkthrough, a case with 2 feet improperly loaded was observed. Over a year, this would lead to an added 1,040 kWh and $92 in costs. Correct case loading takes very little time and no money; however, it must be continually monitored as product is constantly being refilled and rearranged by employees and customers.

Recommendation	Annual Reduction	Annual Savings	Status
Best Practices Guide	5,700 kWh–18,200 kWh*	$500–$1,600*	Implemented at 8 stores
Condenser Cleaning	3,100 kWh–15,600 kWh*	$300–$1,400*	Implemented at 8 stores
Insulation Repair	39,700 kWh	$3,500	Recommended
Awning and Spray Mister	12,100 kWh	$1,080	Implemented
Case Loading	1,000 kWh	$90	Recommended

*Varies by store size and previous observance of best practice.

MnTAP Advisor: Jane Paulson, Senior Engineer

Director's Note

Laura Babcock
MnTAP Director

On behalf of the entire MnTAP team, I am honored to share the 2021 Solutions publication, featuring executive summaries from the work 14 interns accomplished during the summer 2021 MnTAP Intern Program. These projects sought to identify and implement operational changes that create less waste, use fewer hazardous materials, and require less water and energy to deliver high quality products and services to market and save money.

The MnTAP Intern Program 2021 cohort came to the program seeking an opportunity to blend their unique training and talents and address projects with significant environmental and business impact—but they achieved much more. A summer spent with the MnTAP Intern Program allows young professionals the opportunity to explore their capacity for not only solving technical challenges but also leading a project and being accountable for the outcomes achieved. **This is leadership development in action.** It is good to know our future is in such capable hands.

There were challenges and bright spots during the 2021 program. While we needed to conduct our training and team building activities remotely for safety reasons, care packages with tasty snacks helped sustain us through long Zoom sessions. The opportunity for MnTAP staff and interns to meet in person, with masks in place, during our presentation practice sessions was great fun. Sharing the experience of the 2021 MnTAP Intern Symposium together, even if the audience was virtual, provided a celebration of the great summer we all had.

This type of program takes a village to support. The MnTAP Intern Program village includes companies from a wide range of industries. We are grateful the managers at these facilities chose to take a chance on the opportunity to focus on significant projects expected to deliver substantial environmental and business benefit. MnTAP is grateful for our partners who support these projects financially through grants and direct program sponsorship. We strive to be good stewards of these resources and deliver project results with significant impact on businesses and the environment.

We appreciate that you have taken the time to look through the solutions that are presented here and hope you take away a few ideas to try in your locations. The 2022 MnTAP Intern Program is just around the corner and we are looking forward to working with you! Company and student applications are available now on the MnTAP website:

Business Application for MnTAP Intern Program
Student Application for MnTAP Intern Program

"This summer I had the opportunity to gain hands-on experience working in a real-world manufacturing environment. I was challenged with complex problems to solve and given the autonomy and support to develop solutions that will help Miller Manufacturing and the environment. This experience helped me become a more well-rounded student and soon-to-be graduate. I'm grateful for the opportunity MnTAP made possible and loved my time at Miller Manufacturing."

~ Anna Walsweer, 2021 MnTAP Intern

Apply to Become a MnTAP Intern

Students See Success

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

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

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

Interns have represented 31 different majors and more than 28 colleges and universities. In total, 314 students have gained experience through a MnTAP internship over the past 37 years.

Student Benefits

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

Applications are being accepted for summer 2022 internships. Interviews will be held January, 2022 through March, 2022. Selected applicants will be matched to a project based on academic background and performance, relevant experience, and technical skills.

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

2021 Interns

Front Row L-R: Gabriella Martinez-Zamora, Luiza Rabelo, Mia Clark, Claire Schleusner, Anna Walsweer, Audrey Frederick, Abby Reinert
Back Row L-R: Sidharth Laxminarayan, Niklas Martensson, Henri Parenteau, Calvin Harris, Sam Matuseski, Julian Kern Steffen, Fawad Khan

MnTAP SOLUTIONS

Minnesota Technical Assistance Program
McNamara Alumni Center • University of Minnesota
200 Oak Street SE • Suite 350-1 • Minneapolis, MN • 55455
612-624-1300 | www.mntap.umn.edu

About MnTAP

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

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

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

Laura Babcock
MnTAP Director

Daniel Chang
Associate Engineer

Matt Domski
Intern Program Manager

Michelle Gage
Engineer

Nathan Landwehr
Waste Reduction Specialist

Gabrielle Martin
Associate Engineer

Jane Paulson
Senior Engineer

Kira Peterson
Engineer

Alaina Ryberg
Website Designer

Laura Sevcik
Pollution Prevention Specialist

Jon Vanyo
Engineer

Brent Vizanko
Associate Engineer

UNIVERSITY OF MINNESOTA
Driven to Discover®

MnTAP Solutions is printed on chlorine-free, recycled and recyclable paper made in Minnesota with at least 10% post-consumer material.