WORKING TOGETHER TO ACHIEVE ECONOMIC AND ENVIRONMENTAL RESULTS

Pollution Prevention SERVICES 2022

pollution prevention services

INTERN PROGRAM

CASE SUMMARIES

www.iowap2services.com

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DIRECTOR'S NOTE

Conserving and enhancing our natural resources is core to the Iowa Department of Natural Resources' (DNR) mission. Water, a finite resource, has gained prominence during the ongoing drought across much of the state. DNR works to protect and enhance water quality so Iowans have safe, clean water. Iowa companies, partnering with the DNR's Pollution Prevention (P2) Intern Program, are furthering this effort by reducing water usage and improving water quality.

Since 2001, companies hosting P2 interns have reduced their water usage by 5.9 billion gallons. This year, with the majority of projects focusing on water, the P2 Intern Program will result in improving water quality while reducing usage even further. Energy reduction, carbon capture and reuse, and solid waste reduction rounded out the program's projects.

In the P2 program, interns are tasked with assessing operations and processes of their host company and then making recommendations for environmental improvements. For the water focused projects, interns concentrated on reducing usage of treated water and improving wastewater quality. Since treated water requires chemical additives and energy to produce, their recommendations resulted in both environmental and economic savings.

I commend this year's host companies for opening their doors to P2 interns, rethinking their operations, and committing to major process improvements. The project summaries that follow demonstrate their commitment to environmental stewardship, benefiting Iowans—now and for generations to come.

-Kayla Lyon, Director
Iowa Department of Natural Resources

TOTAL IMPLEMENTED SAVINGS 2001–2022

POLLUTION/WASTE REDUCTION & COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	5,903,261,593	gallons	$16,941,996
SPECIAL WASTE	76,137	tons	$1,797,439
SOLID WASTE	190,640	tons	$17,401,691
CHEMICAL USE AND HAZARDOUS WASTE REDUCTION	10,104	tons	$18,517,212
MERCURY ABATED	42,817	grams	
ENERGY	510,103,470 4,041,056 23,000,725	kWh *MMBtu therms	$29,081,795 – $16,370,310
OTHER			$14,262,532
			TOTAL: $114,372,975

**MMBtus are calculated from kWh and therms for special reporting only. All dollars and actual energy saved are reported under therms and kWh.*

2001–2022 GREENHOUSE GASES & CONVENTIONAL AIR POLLUTANTS FROM IMPLEMENTED PROJECTS

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
11.274	661.854	110.438	72.976	1200.120	129.086	380.920

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
305,412.342	74,255.061	3,989.076	2,093.767	394,952.495

» Air emissions and greenhouse gases shown in the following case summaries are Life Cycle estimates and include external activities such as purchasing utilities. Totals do not solely represent emissions generated at the plant sites.

2022 EXECUTIVE SUMMARY

Eight upper-level engineering students teamed with the Department of Natural Resources' 2022 Pollution Prevention Intern Program to help companies meet their environmental objectives. Working onsite at top Iowa companies, interns identify strategies to reduce solid and hazardous waste generation, water, energy, and chemical use, air emissions, and greenhouse gases. Interns research and recommend process improvements that will lower operating costs and improve the environmental performance of host companies. This year, the interns identified opportunities that could save companies more than $4.18 million annually. Of these, projects estimated to save $1.4 million annually were implemented or are in progress.

The intern program is an extension of DNR's Pollution Prevention Services, a non-regulatory program that offers confidential technical assistance to Iowa business and industry. The interns offer a fresh perspective and innovative solutions while gaining valuable experience. Companies are able to have someone onsite, dedicated to compiling data and developing innovative solutions to improve the efficiency of their process.

Projects addressed this year by mechanical engineering students include reduced energy usage in the electrical system, heat recovery and reduction of natural gas usage, capture and reuse of carbon emissions, and integration of a closed-loop cooling process. Chemical engineering students completed projects to reduce paint waste and standardize segregation and collection processes, reduce water usage and explore reuse opportunities in the processes, and optimize the efficiency of a wastewater process and improve effluent quality.

The 2022 case summaries in this book highlight the commitment these companies are making to improve their environmental performance and achieve aggressive sustainability goals.

2022 ENVIRONMENTAL SAVINGS

ACTUAL POLLUTION/WASTE REDUCTION & COST SAVINGS FROM INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	42,561,166	gallons	$690,364
SPECIAL WASTE	12	tons	$199,099
SOLID WASTE	7,180.21	tons	$26,744
HAZARDOUS WASTE	58.33	tons	$144,745
ENERGY	572,613 41,339 393,851	kWh **MMBtu therms	$105,203 – $160,603
OTHER			$100,275
			TOTAL: $1,427,033

**MMBtus are calculated from kWh and therms for special reporting only. All dollars and actual energy saved are reported under therms and kWh.*

TOTAL REPORTED FROM 2022 PROJECTS THROUGH AUGUST

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
0.204	4.424	0.988	0.485	6.900	2.476	4.900

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
1,925.482	589.411	77.016	14.257	2,920.035

NOTE:

» Air emissions and greenhouse gases shown in the following case summaries are Life Cycle estimates and include external activities such as purchasing utilities. Totals do not solely represent emissions generated at the plant sites.

» Greenhouse gas estimates for solid waste reduction projects are derived from U.S. EPA, Waste Reduction Model (WARM), Version 15, available at: http://www.epa.gov/warm.

» Life cycle air emissions and greenhouse gas estimates for all sectors except solid waste are calculated using Carnegie Mellon University Green Design Institute (2022) Economic Input-Output Life Cycle Assessment (EIO-LCA), US 2002 (428 sectors) Producer model [Internet], available from: http://www.eiolca.net/>[Accessed 6 Sept, 2022].

WHAT IS POLLUTION PREVENTION (P2)?

Pollution Prevention (P2) was created by Congress in 1990. The P2 Act focused public attention on reducing the amount of pollution in our air, water, and soil. Government implemented policies to effect change. Business, industry, and individuals started making cost-effective changes in production, operations, raw materials use, and waste management to reduce the pollution being generated and become better stewards of their environment.

P2 is the **reduction** or **elimination** of wastes at the **source** (source reduction) or beginning of a process, instead of at the end-of-the-pipe or stack. So when employing P2 you are looking at the entire process to identify how and where the waste is generated and find ways to more efficiently use your resources. When applying P2 methods, you are also looking at ways to reduce or eliminate hazardous materials.

Seven P2 strategies that categorize most improvements include:

» Input substitution
» Equipment modifications
» Process modifications
» Product reformulation
» Raw material use & handling
» Material tracking & inventory control
» Improved housekeeping & maintenance

When using one or more of these P2 strategies to implement an environmental project you can almost always save your facility money. The project summaries in this document provide an example of how companies can implement environmental projects and at the same time save money.

COMPANY TESTIMONIALS

"We've taken advantage of the professionalism and passion of the P2 staff and interns for 5 years, which demonstrates how much they bring to us each year. This year's intern delivered the same quality investigative work and real-world recommendations. We're already looking forward to next year's partnership."
CHARLES HEISEL, JBS SWIFT PORK

"Our company has already started to benefit from the intern's project by significantly reducing our water usage which consequently also leads to electrical and cost reductions."
ENZO GUAZZO RIZZO, JBS USA

"Our intern was able to dig into our systems and gather data that will help us make strategic decisions in the future. He was able to work independently and dedicate the time and resources to the system that we had historically lacked the band-width for in our day to day activities."
BEN EVANS, POLARIS INDUSTRIES–INDIAN MOTORCYCLE

POLLUTION PREVENTION: COMPANY PROJECT REQUEST PROCESS

FOR COMPANIES WISHING TO MAKE A PROJECT REQUEST

Pollution Prevention Services is currently accepting requests for 2023 intern projects. Companies must submit a project request that identifies a focus project and outlines the desired objectives and impacts. Company project requests must be submitted by December 2, 2022 to be considered for a 2023 intern placement.

Project requests will be reviewed upon receipt and companies contacted within two weeks for review, clarification and further development. Final determination of acceptance will be made within 30 days after project review and clarification of details is completed. Intern assignments for finalized projects will begin in January of 2023.

» SUBMIT PROJECT REQUESTS TO: p2services@dnr.iowa.gov

Project request forms are available at www.iowap2interns.com
Please note: *Students are not trained in or qualified to assess regulatory compliance issues.*

Pollution Prevention Services

For three decades we have provided confidential, non-regulatory assistance to business and industry. We serve Iowa business and industry through the following:

OPPORTUNITY & FOCUSED ASSESSMENTS
A brief site visit to identify opportunities or an in-depth analysis of a single media or process within a facility providing specific recommendations with data to make cost effective decisions.

TECHNICAL ASSISTANCE SUPPORT
Support is available to answer specific questions whether in person, on the phone or in email.

P2 RESOURCE LIBRARY & P2 INFOHOUSE
Our electronic reference library and searchable database of P2 best practices and new technologies is available for continued resource conservation and impact reduction.

ENVIRONMENTAL MANAGEMENT SYSTEMS ASSISTANCE (EMS)
An EMS is an organized formal approach to managing environmental issues. We can assist in implementing your EMS.

WORKSHOPS
Workshops, webinars and learning opportunities offer companies an opportunity to exchange ideas, transfer best management practices and new technologies, and discover innovative source reduction ideas and strategies.

POLLUTION PREVENTION INTERN PROGRAM
Companies submit project requests to obtain an upper-level undergraduate or graduate student to identify, evaluate and implement P2 projects in their facilities.

EQUIPMENT LOAN PROGRAM
Borrow monitoring equipment from P2 Services to collect data on specific systems to support your P2 initiatives.

Iowa businesses working with P2S to implement projects have saved, collectively, more than $114.4 million dollars and become better stewards of their environment. Companies have taken major steps to reduce energy usage, water consumption, waste generation, CO2 emissions, and operating expenses. More information on these services and upcoming events is available at www.iowap2services.com.

2022 Pollution Prevention INTERNS

IS A P2 INTERNSHIP THE OPPORTUNITY FOR YOU?

As an intern in the nationally recognized Pollution Prevention Intern Program, you will work onsite at a company or institution dedicated to protecting the environment and saving money through projects aimed at reducing or eliminating waste and inefficiencies.

JONAH MAGNESON
DEE ZEE, INC.
"I feel like I made a real contribution and my work will have a positive impact on my host company's environmental sustainability efforts."

JESSICA HAMMEL
HNI CORPORATION
"The hands-on industry and networking experience that I gained from this internship was very rewarding."

CAITIE STEELE
JBS SWIFT PORK
"During my internship I felt that I really made an impactful contribution to the environmental goals set forth by the company. The work I started has already begun the process of approval and implementation which is really rewarding to see happen."

ERIK EDENS
JBS USA, LLC
"Having daily interactions with industry professionals including management, engineers, and technical professionals, has provided a valuable experience and wealth of knowledge for my future career goals."

ANNA MEERSCHAERT
MONOGRAM QUALITY FOODS
"I found it rewarding having my own project to work on this summer. It was amazing to see that I was able to assess a system and make feasible recommendations to a company."

BERGEN OLSEN
POLARIS INDUSTRIES–INDIAN MOTORCYCLE
"This internship pushes you outside your comfort zone to engage with others to accomplish the goals of the project. Learning to manage and grow professional relationships in a workplace is extremely valuable for career preparation."

NATHAN SMITH
TYSON FOODS, INC.–HILLSHIRE BRANDS
"My P2 Internship experience was amazing. I gained much more confidence in my engineering abilities and interpersonal communication."

JACOB JONES
WELLS ENTERPRISES, INC.
"This internship was a very good experience. I improved confidence in my abilities as an engineer while gaining first-hand experience analyzing mechanical processes."

POLLUTION PREVENTION: INTERN APPLICATION PROCESS

STUDENTS! JOIN THE P2 INTERN PROGRAM IN 2023!

Upper-level undergraduate students and graduate program engineering students are encouraged to submit the following documents for consideration:

- ☐ Application Form
- ☐ Résumé
- ☐ Cover Letter
- ☐ Unofficial copy of transcripts
- ☐ List of Fall 2022 and Spring 2023 classes

Selection of 2023 interns will begin in November and continue into the spring until project assignments are finalized.

Pollution Prevention Services is offering internships for 12-weeks (May 22–August 11) or for 24-weeks (May 22–November 10) in 2023.

Selected applicants will be matched to a project based on academic performance, relative experience and technical skills.

Application forms are available online at: www.iowap2interns.com.

SUBMIT APPLICATIONS TO: Danielle Roseland

The Iowa Department of Natural Resources is an EEO/AA Employer.

Danielle Roseland | Pollution Prevention Intern Program Coordinator

Danielle.Roseland@dnr.iowa.gov

(515) 217-0010

FAQ: Frequently Asked Questions

WHAT IS POLLUTION PREVENTION?
Pollution Prevention is the act of changing client processes to reduce or eliminate waste and pollutants at the source, minimizing the need for treatment or disposal.

WHO IS ELIGIBLE FOR AN INTERNSHIP?
Upper-level undergraduate students and graduate program candidates are eligible. Selected applicants will be matched to a project based on academic performance, relevant experience, and technical skills. Up to 15 internships will be funded in 2023.

HOW DO PROJECTS WORK?
Interns report to a company supervisor who provides onsite resources and garners management support. They also report to a P2 program advisor who provides technical support. The intern will assess a process, research options, evaluate feasibility, and develop cost comparisons for their assigned project. Interns will also initiate implementation of their recommendations at their host company. Deliverables include a final report documenting results, a case summary of the project, and a presentation to host company management.

WHAT SUPPORT WILL I HAVE?
Internships will begin on May 22nd with a week of training. Interns will learn how to complete an assessment and identify inefficiencies, how to apply P2 methodologies to improve performance and reduce waste, and how to quantify economic and environmental savings. Interns serve as project managers at their host companies and receive technical support from Iowa Department of Natural Resources' Pollution Prevention Services engineers.

BACKGROUND
Pollution Prevention Services is a team of DNR experts offering non-regulatory environmental technical assistance to business and industry, institutions, and government agencies. The internship program matches host companies with students, refines project goals, helps to generate ideas, and keeps projects focused on pollution prevention.

DEE ZEE, INC.

DES MOINES

COMPANY PROFILE

Dee Zee, Inc. is a premier truck accessories manufacturer headquartered in Des Moines, Iowa. The company occupies seven buildings, comprising more than one million square feet, dedicated to manufacturing, packaging, warehousing, and shipping. Approximately 1,000 employees cater to the automotive industry as an Original Equipment Manufacturer (OEM) and also supply product to the retail consumer sector. Dee Zee is the largest manufacturer of running boards and side steps in the world.

Jonah Magneson

MAJOR: Mechanical Engineering
MINOR: Energy Systems
SCHOOL: Iowa State University

PROJECT BACKGROUND

The intern was tasked with analyzing energy consumption in targeted systems and establishing a baseline to prioritize improvement opportunities. This project primarily focused on reducing utility and gas emissions in the oven systems at the main plant. The intern conducted an assessment, explored options and developed an implementation plan to improve efficiency and reduce energy and associated costs. The intern also explored improvement opportunities in the compressed air system.

INCENTIVES TO CHANGE

Dee Zee is committed to environmental sustainability and incorporates LEAN practices, source reduction, and recycling efforts throughout their operations. The company is ISO 14001 certified and relies on vendors that participate in the Sustainable Forestry Initiative to supply their paper and cardboard packaging needs. A sustainability team collaborates to set sustainability initiatives and projects, keeping Dee Zee on track to meet their environmental goals. This year's project to reduce energy usage and associated greenhouse gases fits with Dee Zee's ongoing commitment to environmental continuous improvement.

RESULTS

Insulate Combustion Chambers: The assessment showed that a significant amount of energy is lost through the walls of the combustion chamber. Inside the combustion chamber, air is heated to extremely high temperatures, which is then transferred to supply heat to the ovens for the powder coating process. Installing ceramic insulation around the combustion chamber could improve the thermal resistance of the barrier, helping to maintain the high-temperatures of the energy inside. This insulation could be purchased and installed by a maintenance technician when the gas burners are turned off.

Install Natural Gas Meters: A single meter, located outside the plant, tracks the facility's natural gas usage. More accurate data of the gas usage could be achieved by installing volumetric flow rate meters in each of the natural gas lines that supply the equipment. A continuous flow of gas to the gas burner with and without the meter being present could be achieved by installing two routes of steel piping to the same heating unit. The increased data tracking would allow Dee Zee to monitor trends and identify areas of opportunity to reduce natural gas usage.

Repair Compressed Air Leaks: Using an ultrasonic leak detector, the intern located and quantified leaks in the compressed air system. Leaks in the compressed air lines make the compressors work above their optimal setpoint. The majority of leaks were found in connection points between compressed air lines or at end use applications. Repairing these compressed air leaks would allow the air compressor to operate at a lower setpoint. Teflon tape can be used to seal the threading where the leaks are occurring. A regular maintenance plan with an ultrasonic leak detector could identify leaks as they occur and save on energy costs associated with the compressed air system.

Adjust and Replace Compressed Air Filters: Manual air filters are in place to filter out contaminants in the compressed air lines. When these filters are inadvertently left open, contaminants and compressed air exit the line. Replacing the manual filters with automatic filters allows for lines to be kept closed while the contaminants are being drained out. These filters do not require an external power source or maintenance. The automatic air filters could directly replace the manual filters in the line with minimal maintenance.

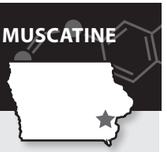
Compressed Air and Natural Gas Pipe Mapping: Compressed air and natural gas lines run along the decking inside of the main plant. From the ground, the pipes all look similar. The intern created piping and instrumentation diagrams of the compressed air and natural gas lines at the main plant to help identify and locate the pipes. While not yet to scale, the diagrams give guidance as to where the pipes are located to assist with maintenance.

Preventative Maintenance: Preventative maintenance could eliminate unplanned down time and leaks during production. Build-up of paint in the nozzles on the powder coat paint line can create flow issues and even cause clogging, making it necessary to stop the process to clean the nozzles. Cleaning the nozzles in the paint booth and washing units while the ovens are purging could increase efficiency and prevent the line from being shut down unexpectedly, reducing down time.

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSULATE COMBUSTION CHAMBERS	$68,148	136,295 therms	RECOMMENDED
INSTALL NATURAL GAS METERS	$4,849	9,782 therms	RECOMMENDED
REPAIR COMPRESSED AIR LEAKS	$16,840	120,152 kWh	RECOMMENDED
ADJUST AND REPLACE COMPRESSED AIR FILTERS	$5,059	36,134 kWh	RECOMMENDED
COMPRESSED AIR AND NATURAL GAS PIPE MAPPING	$900 (ONE-TIME)	–	IMPLEMENTED
PREVENTATIVE MAINTENANCE	$22,251	158,934 kWh	RECOMMENDED

HNI CORPORATION

MUSCATINE



COMPANY PROFILE

HNI Corporation is a global family of industry-leading brands for the workplace and home. As a quality-driven manufacturer of workplace furnishings, HNI offers a broad collection of solutions that support work environments from the home office to the large commercial campus. As a maker of residential building products, HNI is the world's leader in hearth products. Headquartered in Muscatine, HNI operates four facilities in this Iowa community and more across the country and globe, employing more than 8,700 members worldwide.

Jessica Hammel

MAJOR: Chemical Engineering
SCHOOL: Iowa State University

PROJECT BACKGROUND

The P2 intern conducted an extensive data analysis of HNI's waste generation and costs, using P2 strategies to develop recommendations aimed at reducing solid waste going to the landfill. Data on many of HNI's different waste streams was collected and analyzed, with a main focus on paint waste and wood waste generated from the company's Muscatine production facilities. Solid waste weights, costs, and trends were all analyzed and broken down by each local production facility. The intern also analyzed the paint process to identify opportunities to optimize paint usage.

INCENTIVES TO CHANGE

HNI currently has a goal to move all company facilities to zero-waste-to-landfill status by the year 2030. More specifically, HNI is aiming to achieve a 95 percent diversion rate for each of their company sites. One of the first steps in achieving this goal is completing waste mapping exercises and in-depth waste profiles for each company location, including developing solutions for difficult-to-recycle materials. A focus on reducing large volume waste streams such as wood waste and paint waste is a major step towards achieving this goal.

RESULTS

Solid Waste Data Analysis: At the beginning of this project, an extensive analysis of paint and wood waste data was completed to create a baseline of total weights and costs for the generated wastes. The throughputs for paint sprayed and paint wasted for the four different Muscatine production facilities were compared. Landfill costs were used to estimate an average yearly cost to landfill the wasted paint.

To determine the weight and cost of wood waste, monthly load count summaries of outgoing wood waste and landfill tickets were used. The monthly summaries were used to determine an estimated weight of each load. Once the weight was estimated, the landfill tickets were used to determine transportation costs and tipping fees and generate an average annual wood waste disposal cost.

In addition to data analysis, time was also spent participating in a Rapid Continuous Improvement (RCI) event, with a goal of reviewing solid waste generation at the Muscatine production facilities and creating a standardization for waste bins located throughout the facilities to improve uniformity and access to production recycling receptacles. After the conclusion of the RCI, the P2 intern spent time at four different production locations to aid in the implementation of this effort.

Paint Waste Recovery: There are four different HNI facilities in the Muscatine campus that run powder coat paint lines. Paint that is not transferred to the products is collected as waste and sent to the landfill. Instead of disposing of the waste paint, HNI is looking into a company that would be able to take the paint waste and re-extrude it into custom colors. HNI would then be able to buy back this paint at a portion of the original cost instead of buying brand new paint. If this project moves forward, HNI would be able to completely recapture all of their paint waste, eliminating the waste stream and furthering the company's zero-waste-to-landfill goal. Initial samples of paint waste have been sent for evaluation and trials. Team members at HNI will evaluate the recycled paint to see if it meets internal quality and use specifications.

Painter Training: An effective and ongoing training program for the company's painters could have numerous benefits including increased productivity, less paint waste and overspray, and reduced costs. Currently, HNI painters receive an annual training that is provided by vendors and limited to basic operation of the painting equipment. New painters are provided training and mentoring by senior painters when they are initially hired, potentially causing variability in the detail and depth of knowledge shared. Hiring an outside vendor experienced in delivering customized painter training would be an asset to the company's paint operation. Focused on proper technique, optimizing transfer efficiency and minimizing overspray, the training could take place at HNI's facilities and be provided annually to all company painters.

This recommendation is currently under review. If approved and funding is allocated, lead workers for each facility's painting operation will work with management to plan and coordinate training scheduling and logistics.

Wood Waste Reduction: Wood waste is produced at five different HNI Muscatine locations. The waste generated is primarily particleboard cutoff pieces along with the resulting dust created during the cutting process. Once the scrap particleboard is collected, the larger pieces are ground up and landfilled. As an alternative, HNI has identified a company that may be able to accept this wood waste and use it as a waste-to-energy fuel source. Sending waste to this company will cost HNI slightly more than sending it to the landfill, but diverting this material brings HNI closer to its zero-waste-to-landfill goal. This project has been signed off on by Management, capital has been approved, and it is in the process of being implemented.

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
SOLID WASTE DATA ANALYSIS	$4,200 (ONE TIME)	–	IMPLEMENTED
PAINT WASTE RECOVERY	$950,535	372.7 tons	RECOMMENDED
PAINTER TRAINING – LANDFILL DIVERSION	$1,902	41.8 tons	RECOMMENDED
PAINTER TRAINING – IMPROVED EFFICIENCY	$51,010	–	RECOMMENDED
WOOD WASTE REDUCTION	–	7,014 tons	IN PROGRESS

JBS SWIFT PORK

COMPANY PROFILE

JBS S.A. is the world's largest protein producer with nearly 400 operating locations in fifteen countries. A subsidiary, JBS USA, a leading global food company, is headquartered in Greeley, Colorado. As the nation's second-largest producer of fresh pork, JBS USA delivers high-quality food products to customers in more than 125 countries on six continents. The company operates six pork production facilities, including JBS Swift Pork in Ottumwa, Iowa. The Ottumwa plant employs more than 2,400 team members and is a major contributor to the international pork market with production numbers averaging 21,000 hogs per day.

Caitie Steele

MAJOR: Mechanical Engineering
MINOR: Biomedical Engineering
SCHOOL: Iowa State University

PROJECT BACKGROUND

JBS Ottumwa identified carbon dioxide (CO_2) capture and utilization as a key, potential strategy in achieving a closed loop system. The aim of this project was to evaluate carbon dioxide offset potential based on the facility's current CO_2 and biogas generation and usage. To accomplish this, the intern conducted a feasibility study, comparing carbon capture strategies and technologies at an industrial facility similar to JBS' size and sector. The intern also analyzed internal operational processes, identifying opportunities for CO_2 usage reduction.

INCENTIVES TO CHANGE

In March 2021, JBS became the first global meat and poultry company to commit to achieve net zero greenhouse gas emissions by 2040. Included in this commitment, JBS pledged to use 100 percent renewable electricity by 2040 and to cut emissions by 30 percent by 2030. This environmental commitment was made in addition to existing efforts to reduce water usage and increase renewable energy sources from previous years. JBS pledged $1 billion (USD) for emission reduction projects and another $100 million for the research and development of emission mitigation technologies.

RESULTS

Carbon Capture System: Carbon dioxide is currently emitted to the atmosphere at JBS Ottumwa as a by-product from its stationary combustion operations and onsite industrial wastewater treatment plant. A demand for CO_2 inside the plant is needed for process operations and maintaining dry ice quality. The implementation of a carbon capture system could both significantly reduce greenhouse gas emissions and contribute to JBS Ottumwa becoming self-sufficient in carbon dioxide supply. The capture system could also provide consistency and stability to JBS' CO_2 costs – a significant benefit given increasing market prices for CO_2 and decreased availability of liquid carbon dioxide, caused by carbon sequestration market growth.

The project recommendations include the installation of a post-combustion capture system that utilizes an amine-based solvent with chemical specificity to CO_2 to filter the carbon from the rest of the flue gas. Operating such a system could allow JBS to collect and scrub the exhaust gas from the boiler stacks. In addition to the avoided purchasing costs for production, excess captured CO_2 could potentially be sold as a commodity, offsetting system costs. Further stack testing is needed to ascertain specifications for a request for proposal.

Dry Ice Production: Dry ice is purchased from a third-party vendor to refrigerate products through delivery to the customer. To maintain control over the quality and quantity of the dry ice needed, the intern recommended the installation of dry ice pelletizers, along with additional recovery systems. Since existing CO_2 storage tanks meet the required inlet specifications for the pelletizers, dry ice production can occur onsite with or without a facility carbon capture system in place. Quotes for two pelletizers with additional recovery systems estimated that the proposed equipment could reduce dry ice waste by 11.6 percent, resulting in decreased costs. In addition, onsite dry ice production could significantly reduce dry ice loss from sublimation and address over and under ordering concerns. The equipment proposal is now being reviewed by JBS management.

Dry Ice Handling SOPs: In an effort to move JBS Ottumwa forward to meet industry standards for dry ice waste due to sublimation, the intern recommended implementing standard operating procedures (SOPs) at a number of identified production areas. Recommended SOPs prioritize usage, first by utilizing partially filled totes and totes with the oldest dry ice, and also replacing lids when totes are not in use or during production breaks. These recommendations were passed along to JBS management, and changes are being implemented.

Hinged Dry Ice Lids: Dry ice sublimation losses occur when lids are left off of totes by employees who may find the large, bulky lids difficult to maneuver throughout the production day. Adding hinged lids to the dry ice totes will allow employees to easily close the totes when not in use. Lids could be constructed in-house from plastic in a high contrasting color for optimal visibility on the plant floor. To implement this recommendation, plant staff need to design and construct the hinged lids and then fit the totes.

Reduce Stunner Levels: JBS Pork utilizes CO_2 stunning equipment as a humane method to render hogs unconscious before slaughter. The stunning equipment is currently set to use more CO_2 than necessary based on equipment design specifications. Incrementally scaling back the CO_2 concentrations in the stunners, until the average usage per animal reaches that of other JBS pork plants, could save 8 percent of the carbon dioxide used while still exceeding safety factors based on equipment specifications. Management has been informed of the savings potential and is moving forward with verification with the Quality Assurance department.

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
CARBON CAPTURE SYSTEM	$279,994	23,400.00 $MTCO_2$	RECOMMENDED
DRY ICE PRODUCTION	$246,664	2,914.81 $MTCO_2$	RECOMMENDED
DRY ICE HANDLING SOPS	$17,088	201.63 $MTCO_2$	IN PROGRESS
HINGED DRY ICE LIDS	$7,549	67.21 $MTCO_2$	RECOMMENDED
REDUCE STUNNER LEVELS	$22,465	243.78 $MTCO_2$	RECOMMENDED

JBS USA, LLC

MARSHALLTOWN

COMPANY PROFILE

JBS USA is a subsidiary of Brazilian company JBS S.A., and is headquartered in Greeley, Colorado. JBS USA is a leading producer of beef, pork, and poultry, producing more than 280 million servings of protein daily around the world. The company employs more than 66,000 team members. The pork facility in Marshalltown, Iowa, processes about 21,000 head per day and employs close to 2,500 people.

Erik Edens

MAJOR: Chemical Engineering
SCHOOL: The University of Iowa

PROJECT BACKGROUND

This year's intern project at JBS Marshalltown focused on water conservation, with an emphasis on water reuse and reduction. The intern was tasked with identifying water savings opportunities and recommending equipment modifications to achieve environmental and economic savings. Assessments were conducted throughout different areas of production, with increased attention to the largest water using systems. Repurposing cooling water streams and reducing process water consumption were revealed as key areas of interest. Recommendations were offered after considering complexity of implementation and cost savings opportunities.

INCENTIVES TO CHANGE

In 2021, JBS committed to a net zero emissions goal by 2040, becoming the first global meat and poultry company to make such a pledge. Water conservation measures have the potential to propel JBS forward in achieving this ambitious goal. Emissions can be avoided by decreasing water usage, which in turn decreases energy needed for moving, chilling and heating water. Water conservation has both environmental benefits and economic savings. JBS, driven by its commitment to continuous environmental improvement, aims to reduce water usage by 15 percent in its Marshalltown plant by 2030.

RESULTS

Bone Crusher Cooling Water Efficiency: The ham boning section of the facility features a bone crusher area where meat from the ham line is harvested off bones. Crushing equipment utilizes a hydraulic system with presses, each requiring a cooling water stream for their oil reservoirs. After measuring the flow rates of this cooling water, each stream was found to be exceeding equipment flow rate specifications – providing more cooling water than needed. Reducing the flow rates to be more in line with specifications could save overall water usage. Additionally, a shutoff program could be established so the cooling water is not flowing overnight and on weekends when the equipment is not in use. This can be done without significant investment by changing the shutdown and startup operating procedures and installing various flow controls.

Substitute Carcass Wash Water with Singer Rail Water: A rail system is used to transport hogs through the various stages of production. In the dehair section of the plant, singers use natural gas to singe the remaining hair from the hogs before they continue for further processing.

The north singer has a cooling water stream running along the rail section to prevent warping due to the heat from the singer. This water goes directly to the drain without secondary use.

This water could be rerouted and used in the nearby carcass wash since the flow rates and pressures needed are the same. Implementation would require installing new piping to reroute the water stream.

Flow Control on Dehair Machines: There are four machines in the dehair section of the plant that use recirculation pumps to recycle water continuously through the top of the machines. The dehair machines require a high volume of makeup water, causing these machines to be one of the largest areas of water usage in the plant. The amount of makeup water is regulated by actuating a ball valve until there is a specified amount of overflow. Commissioning valves could provide better accuracy in controlling the makeup water and minimizing overflow. After updates are completed to the dehair units, commissioning valves could be installed by maintenance staff.

Weekend Water Shut-off: While most of the facility shuts down on weekends, there is still significant unidentified water usage. Over the course of several weekends, sources of unnecessary water use were identified, measured and documented. It is recommended that a weekend water team is created with designated employees to perform quick walk-throughs and turning off water at the beginning of each weekend. Implementation will require identifying and training selected employees to fulfill this team role.

New Fitting on Casings Sink: A sink in the casings building was losing a significant amount of water due to a broken fitting. The broken fitting was causing the tube to dislodge due to backpressure when the sink was off. The issue was reported and maintenance staff promptly addressed the issue and repaired the leak.

Steam Leak Repair: A significant steam leak was observed on the roof above the rendering area where meat material from the ham line and loin boning areas are pumped to the Rendering Department. Steam currently runs through a tracer line that keeps the pipes warm so that they don't get clogged in the winter months, but this steam is not needed in the summer months. Repairing the steam leak would prevent the loss of water and energy when steam is needed in the colder months. Turning this steam flow off during warmer months could generate additional water and energy savings. Implementation would require modifying the pipe on the tracer line.

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
BONE CRUSHER COOLING WATER EFFICIENCY	$29,440	4,463,344 gallons	RECOMMENDED
SUBSTITUTE CARCASS WASH WATER WITH SINGER RAIL WATER	$87,197	13,219,800 gallons	RECOMMENDED
FLOW CONTROL ON DEHAIR MACHINES	$303,379	56,108,160 gallons	RECOMMENDED
WEEKEND WATER SHUT-OFF	$47,333	8,289,590 gallons	RECOMMENDED
NEW FITTING ON CASINGS SINK	$12,134	1,839,600 gallons	IMPLEMENTED
STEAM LEAK REPAIR	$1,727	3,948 therms 5,304 gallons	RECOMMENDED

MONOGRAM QUALITY FOODS

DENISON

Anna Meerschaert

MAJOR: Chemical Engineering
SCHOOL: Iowa State University

COMPANY PROFILE

Monogram Quality Foods is a food manufacturing company that specializes in bacon production. The company produces cured pork bellies that are processed, smoked, pressed, sliced and packaged for retail and food services. The Denison, Iowa, facility has 110,000 square feet of manufacturing space with six high speed slice lines and one automatic bacon layout line. The Denison facility is also the majority supplier of pressed belly slabs for the Monogram Prepared Meats plant in Harlan, Iowa, where it is processed into ready to eat bacon. Monogram Quality Foods is a major employer in Crawford County with 300 employees over three shifts, divided into two shifts for production and one for sanitation.

PROJECT BACKGROUND

The focus of Monogram's project was to optimize the efficiency of the wastewater pre-treatment process and improve the quality of effluent water sent to Denison Municipal Utilities (DMU). Monogram uses a dissolved air flotation system (DAF) to separate and remove solids from the wastewater produced at the plant. Testing of the wastewater was needed throughout the process to understand the incoming effluent quality and assess the efficiency of the DAF system. Optimizing the efficiency of this process could reduce chemical usage and loading levels of the effluent water.

INCENTIVES TO CHANGE

Environmental sustainability is a driving force for Monogram Quality Foods. The company's goal is to limit environmental impact while maximizing profits. There are multiple benefits to reducing solids in the wastewater stream. Filtering the wastewater stream will decrease the non-organic solid waste sent to the landfill, increase the amount of inedible by-product, which is a marketable commodity, and improve effluent water quality. Improving effluent quality during onsite pre-treatment will reduce chemical and energy use at DMU and reduce wastewater utility charges, increasing Monogram Quality Foods' economic savings.

RESULTS

A baseline assessment was conducted on the wastewater pre-treatment system. The pre-treatment system was evaluated using flow rates, solid waste generation, energy consumption, raw material, and maintenance. Solid waste from the production floor is the largest contributor affecting the efficiency and quality of the DAF system. The solid waste found in the wastewater stream decreases pipe and pump efficiency, increasing the amount non-organic solid waste being landfilled.

A third party is hired by Monogram to clean and sanitize the facility each night after the second shift of production. Equipment is rinsed with water to remove any solids and then sprayed with foam chemicals to sanitize the equipment. Improving the dry and wet clean-up processes during sanitation could reduce the solids in the wastewater and improve the efficiency of the DAF system. Since a third party is contracted for this process, incentives and monitoring should be a part of the implementation to ensure continued compliance.

The intern made two recommendations based on the premise that solid waste is quantifiable and has the potential to be reduced. The recommendations are to implement a solid waste reduction plan and shut off the DAF system. Reducing the solid waste found in the wastewater stream will reduce Monogram Quality Foods' environmental impact from the source, optimize the DAF system, and improve the quality of effluent water. Shutting off the DAF system is projected to generate the largest economic savings while reducing energy and chemical consumption.

Solid Waste Reduction Plan: It is recommended that Monogram implement a two-phase solid waste reduction plan. Phase one consists of a third-shift cleanup supervisor, new third-shift standard operating procedures for the dry and wet cleanup processes, and an employee cleanup incentive program. Phase one will allow Monogram to standardize their dry and wet cleanup processes and to quantify and reduce the number of solids found in the wastewater stream. Phase two consists of total drain replacement for older drains throughout the facility. Phase two would allow Monogram to capture the waste solids from production before entering the wastewater stream and minimize clogging in the drains of the facility. Implementation of both phase one and two of the solid waste reduction plan are necessary to improve the wastewater quality and optimize the DAF efficiency to gain the most impactful results.

DAF Shut Off: Currently, the DAF system runs continuously, consuming energy and chemicals. Effective collection of solids prior to entering the wastewater could allow for the DAF system to be shut down, saving money on operational, maintenance, and labor costs. DMU has the capacity to treat Monogram Quality Foods' effluent wastewater. Reducing solids and improving the wastewater quality at the source could allow the company to send the wastewater directly to DMU for final treatment. Additionally, Monogram Quality Foods would reduce their environmental impact by reducing energy and chemical use. Prior to shutting off the DAF system, Monogram Quality Foods must ensure compliance with DMU's quality standards. This would include testing the influent water for biochemical oxygen demand, total suspended solids, total kjeldahl nitrogen and quantities of fat, oil, and grease.

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
SOLID WASTE REDUCTION PLAN	–	134 tons of solid waste	IN PROGRESS
DAF SHUT OFF	$227,799	158,411 kWh 72,605 lbs. of coagulant 5,508 lbs. of flocculant 33,048 lbs. of NaOH 5,508 lbs. of H_2SO_4 2,400 hours of labor DAF Maintenance Cost	IN PROGRESS

POLARIS INDUSTRIES –INDIAN MOTORCYCLE

SPIRIT LAKE

COMPANY PROFILE

Founded in 1954 and headquartered in Medina, Minnesota, Polaris Industries has risen to become the global leader in powersports. Encompassing 35 different brands, Polaris manufactures off-road vehicles such as ATVs and snowmobiles, slingshots, motorcycles, boats, neighborhood electric vehicles, and aftermarket parts. With $8.2 billion in sales in 2021, Polaris employs 16,000 people, and serves more than 120 countries. The facility in Spirit Lake, Iowa, is 400,000 square feet and employs more than 450 people. Although a variety of products have been manufactured at this facility in the past, currently, the facility exclusively manufactures Indian Motorcycles. The facility operates one production shift and is the only Indian Motorcycle manufacturing plant in the United States.

Bergen Olsen

MAJOR: Mechanical Engineering
SCHOOL: The University of Iowa

PROJECT BACKGROUND

The intern was tasked with conducting an assessment to gather data and identify areas of opportunity to reduce electric and natural gas usage. This involved analysis of the compressed air systems, the production lines, and both the metal and liquid paint systems. The intern's responsibilities included establishing a baseline of electrical and natural gas use and providing recommendations resulting in economic and environmental savings while maintaining current production levels.

INCENTIVES TO CHANGE

Indian Motorcycle is moving toward development of an energy management plan to improve energy usage in the facility. This alignment furthers the corporate sustainability goals to increase renewable energy use, reduce electricity consumption, and reduce greenhouse gas (GHG) emissions. Polaris has established aggressive company-wide goals to reduce energy consumption and emissions by 30 percent each and to supply 75 percent of electricity usage from renewable resources, all by 2035.

RESULTS

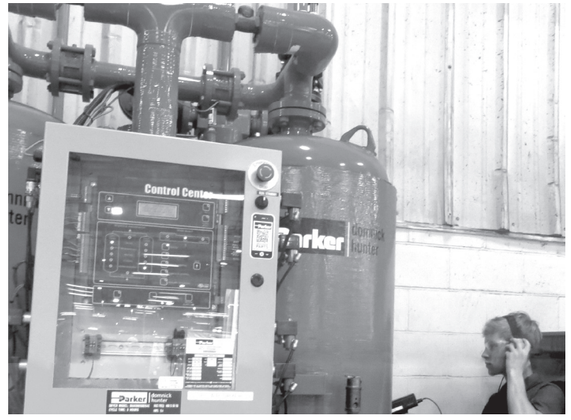
Install Light Occupancy Sensors: Lighting throughout the plant is currently supplied by high bay LED bulbs. Currently, only 28 percent of high-bay fixtures in the facility are equipped with occupancy sensors. The lights that do not have sensors remain on 24 hours per day, seven days per week. More than 80 percent of the high bay lights in the facility could be retrofitted with occupancy sensors while maintaining the same light levels. Sensors with infrared technology will not falsely activate due to non-human objects such as fans or conveyors. The light sensors could be purchased and installed by maintenance during off-production hours.

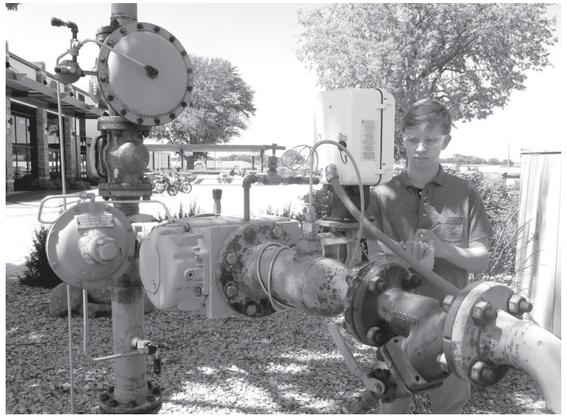
Reconfigure Baler Motor: Polaris operates a baler to collect and bale their recyclable cardboard. Within the baler is a photoelectric sensor that senses when the cardboard level is high enough to compact. The hydraulic pump for the baler is only required to run when compaction needs to occur, which averages a few times an hour, but in actuality the pump runs continually throughout production. By retrofitting the baler with a controller and contactor, motor operation will be limited to only when the photoelectric sensor signals there is enough cardboard to compact. This recommendation will have minimal impact on operator duties as it does not require any training or modification to working routines.

Repair Compressed Air Leaks: Polaris uses compressed air throughout their production process. Air leaks in the compressed air system can result in unnecessary electric costs as the compressors work overtime to replace the leaking air. Using an ultrasonic leak detector, compressed air leaks were found throughout the facility at various quick connects, regulators, and pneumatic tool hoses. A map of the leaks was created and each leak was tagged for repair. Repairing the leaks will reduce the electricity costs associated with air use by approximately 10 percent. Leak repair can be done in-house during off-shift hours by the maintenance team.

Install Natural Gas Flow Meters: Sub-metering allows for analysis of data and identification of inefficiencies leading to an optimization of usage through system or process changes. There are six natural gas sub-meters within Polaris' production facility, but they are not currently recording data. Adding an input/output module and an Ethernet cord for the panel box of each meter will bring it online and allow them to begin recording data. Additionally, moving one of the meters from an unused line to the liquid paint supply line would be a more value-added location and provide accurate measurement of the total natural gas consumed by the liquid paint system. The natural gas flow meters can be updated and reconfigured by maintenance during off-production hours. Data collection may begin shortly after installation.

Install Compressed Air Flow Meters: Installing flow meters on compressed air lines provides a facility with more specific data that can be used to identify and correct inefficient processes. Flow meters can also help identify system leaks. Installing two meters to monitor the compressed air usage by Polaris' paint system, the largest user of compressed air in the facility, will form an understanding of usage while maintaining a low cost of implementation. The compressed air meters can be purchased and then installed by maintenance staff. Once installed, data will be available for review and adjustments can be made to the system to help maintain optimum efficiency.





PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL LIGHT OCCUPANCY SENSORS	$28,500	260,000 kWh	RECOMMENDED
RECONFIGURE BALER MOTOR	$7,300	66,300 kWh	IN PROGRESS
REPAIR COMPRESSED AIR LEAKS	$11,560	105,090 kWh	RECOMMENDED
INSTALL NATURAL GAS FLOW METERS	$19,600	26,800 therms	RECOMMENDED
INSTALL COMPRESSED AIR FLOW METERS	$1,425	12,950 kWh	RECOMMENDED

TYSON FOODS, INC. –HILLSHIRE BRANDS

STORM LAKE

Nathan Smith

MAJOR: Chemical Engineering
SCHOOL: Iowa State University

COMPANY PROFILE

Tyson Foods, Inc. (Tyson), founded in 1935, is a multi-national company, employing approximately 137,000 team members at 268 processing facilities, offices, hatcheries and distribution centers globally. Tyson is one of the world's largest food companies and a recognized leader in protein that processes meat and produces prepared foods. Within the process foods division is Tyson's Hillshire Brands Storm Lake, Iowa, facility that has a daily capacity to process 36,000 turkeys. Operating five days per week with two eight-hour production shifts and one sanitation shift, the facility produces bulk quantities of white and dark meat and creates sausage blends.

PROJECT BACKGROUND

Water is essential to poultry processing. At Tyson's Storm Lake turkey facility, water is used for scalding, defeathering, evisceration, product movement, and sanitation. The project focused on identifying water reduction and reuse opportunities in the evisceration process, the stage where the greatest volume of water is used. The intern also assessed potential water conservation outcomes for implementing a water leak maintenance program and upgrading sanitation hoses.

INCENTIVES TO CHANGE

Tyson is constantly striving for excellence and evolving to better meet the increasing demand for protein in responsible and sustainable ways. The company has a strategy at the corporate level to "Sustainably feed the world with the fastest growing protein brands for future generations." The Hillshire Brands facility also follows Tyson's best practices to work "to build a more sustainable food system," with efforts to meet yearly facility water usage reduction goals.

RESULTS

Evisceration Wash Cabinet Reuse: In the evisceration process, multiple wash cabinets use potable water to rinse turkeys. The intern determined that water consumption could be reduced by using reuse water in the first two wash cabinets. After investigating multiple water reuse systems, the intern recommended directing water from the largest wash cabinet near the end of the line into a separate vessel. This separated by-product water could replace potable water in two upstream processes or be routed back to the same wash cabinet. Implementation of the recommended water reuse system is projected to result in a measurable reduction in water and natural gas usage, as detailed in the table below. The economic feasibility of an installation was ascertained by requesting vendor proposals.

Evisceration Nozzle Modification: In an effort to identify water reduction opportunities, the intern investigated alternative spray nozzles in two evisceration wash processes. Water flow rates of pressurized nozzles on select pieces of equipment were quantified, using a bucket, a stopwatch, and an ultrasonic transit time flow meter. The intern identified two locations where new nozzles could reduce hot water consumption by approximately 1.5 million gallons and lower natural gas usage by approximately 3,000 therms, annually. The nozzles were installed and the intern initiated testing with the Food Safety and Quality Assurance (FSQA) and evisceration departments to evaluate efficiency. Additional testing is needed to determine optimum alternative nozzle orientation and nozzle combinations.

Once the new nozzle combinations and orientation have been fine-tuned, this recommendation could be replicated throughout the evisceration process. Two additional locations have been evaluated for the new nozzles, thus far. Approximately 5 million gallons of water and 4,000 therms of natural gas could be reduced with this replication. Testing is also needed to determine optimum alternative nozzle orientation and combinations for these additional areas.

Evisceration Procedure Modification: During normal operating hours, team members have two breaks. Water is to be turned off as team members go to break and turned on when they return. The intern observed that water was inconsistently shut off during these times. To help ensure water would be shut off, designated team members were identified and engraved stainless steel tags were purchased to help designated team members identify which valves to turn off before breaks. According to an evisceration supervisor, this procedure for turning off and on water in evisceration is working well.

Evisceration Automation: Future facility plans to automate the evisceration process with more accurate and efficient technologies have the potential to reduce hot and cold water usage and reuse water throughout the process. This project requires replacing most of the equipment in the evisceration process and testing and approval of the FSQA department. Automated evisceration could be implemented at the Storm Lake facility by late 2023 or mid-2024.

Leak Maintenance: Throughout the facility, the intern observed various water leaks, most coming from water hoses. In discussing repair procedures with a maintenance supervisor, it was found that all maintenance-related repairs are reported word of mouth via radio or through reporting software. Unless the repair is a critical safety issue or emergency, repairs should be reported using the software which creates a work order that is prioritized, tracked and will ensure the work is completed. The intern emphasized that communication is critical for repairs to be completed in a timely manner that in turn, limits water waste.

Sanitation Spray Guns: Sanitation is crucial to any poultry processing facility. A portion of the hoses used to sanitize equipment at the Storm Lake facility are equipped with spray guns and nozzles while others are simply open-orifice hoses. For consistent application and ease of use, new spray guns were purchased for the open-orifice hoses. The additional spray guns also eliminate excess water waste and increase efficiency.

It should be noted that the facility has elevated several of these projects, making it a discussion point in their continuous improvement meetings.

PROJECT	ANNUAL COST SAVINGS	ANNUAL PROJECTED REDUCTIONS	STATUS
EVISCERATION WASH CABINET REUSE	$221,942	21,120,000 gallons 44,035 therms	RECOMMENDED
EVISCERATION NOZZLE MODIFICATION	$16,352	1,556,303 gallons 3,241 therms	IN PROGRESS
EVISCERATION PROCEDURE MODIFICATION	$81,028	8,104,797 gallons 10,894 therms	IN PROGRESS
EVISCERATION AUTOMATION	$124,404	12,393,600 gallons 171,348 kWh	IN PROGRESS
LEAK MAINTENANCE	$1,669	184,047 gallons	IN PROGRESS
SANITATION SPRAY GUNS	$28,726	3,167,000 gallons	IN PROGRESS

WELLS ENTERPRISES, INC.

COMPANY PROFILE

Wells Enterprises, Inc. is the largest family-owned ice cream manufacturer in the United States. The company was founded in 1913 and is headquartered in Le Mars, Iowa. There are two manufacturing plants in Le Mars, as well as plants in Nevada, New Jersey, and New York. Wells has more than 4,000 employees nationwide and produces more than 200 million gallons of ice cream per year. Their mission is to be the most admired ice cream company in America. The company intends to do so by being a leader in quality, innovation, food safety, and operational effectiveness.

Jacob Jones
MAJOR: Mechanical Engineering
SCHOOL: Iowa State University

PROJECT BACKGROUND

The focus of this project was to reduce the amount of water used at the Le Mars plants. Large amounts of water consumption are attributed to single pass water systems being used for heat transfer. At both plants, water is used to heat up product to bring it to melting temperature. At one of the plants, cold water is used to reduce the temperature of their air compressors. The intern analyzed these systems and researched more efficient alternatives. The impact of alternative systems was calculated, and feasible solutions were recommended to the company.

INCENTIVES TO CHANGE

Wells Enterprises is committed to sustainable manufacturing practices and strives to improve efficiencies and reduce environmental impacts in all facets of its daily operations. Pre- and post-treatment processes used for water can be costly. Decreasing water usage at the plant translates to reductions of water softener, natural gas, and chemicals. Eliminating single pass heating and cooling processes are projected to significantly reduce operational costs and transfer directly to the bottom line.

RESULTS

SICP and NICP Glycol Heating Systems: At the South and North Ice Cream Plants (SICP and NICP), hot water is currently used to melt chocolate for different products. Four lines at the SICP and two lines at the NICP use this process. In the process, water enters the plant at approximately 55 degrees Fahrenheit and is treated with water softener. The majority of the water is pumped to the production lines. Some water is routed to a natural gas fueled boiler for steam. This steam is sent to the production line where it is introduced to cold water using a steam and cold water mixing unit. This unit allows the operator to adjust a valve to control the amount of steam flowing through the pipe until a desired water temperature of 110 degrees Fahrenheit is met. At this time, the heated water is circulated around a tank of chocolate. If the water is too cold, the chocolate will harden and can clog the lines. If the water is too hot it will scorch the chocolate, leading to wasted product. After the water is used to heat the chocolate, it is treated with a chloride treatment chemical and is sent to the Le Mars Sewage Treatment Plant for disposal.

Using a closed-loop, glycol heating system to heat the chocolate on each line would significantly reduce usage of water, water softener, natural gas, and chemical at both the SICP and NICP. With a closed-loop system, the glycol solution would be heated up using an electric heater. The heated glycol would be circulated through the chocolate tank and back to the heater. This system would also result in a more consistent temperature for the chocolate.

To move forward with this recommendation at the NICP, equipment must be purchased and installed on each line using the current heating process. At the SICP, the equipment already exists and will only need to be installed.

NICP Air Compressor Cooling System: The NICP uses water to keep the air compressors at an optimal operating temperature. When the air compressors are in operation, heat needs to be removed from the oil in circulation. A shell and tube heat exchanger is currently being used, with oil passing through the tube and water passing through the shell. The water enters the heat exchanger at 55 degrees Fahrenheit and leaves at 95 degrees Fahrenheit. After this, the water is treated with a chloride treatment chemical and sent to the Le Mars Sewage Treatment Plant for disposal.

The recommended solution is to install a glycol cooling system for the air compressors. The shell and tube heat exchangers will have glycol running through them instead of water. The hot glycol would be pumped to a cooling tower where the lines are sprayed with water and cooled through evaporation. In summer months the cooling tower will not provide enough cooling, so a plate and frame heat exchanger using ammonia refrigerant will further cool the glycol. The cooled glycol will continue to circulate, repeatedly cooling the air compressors. This recommended system will result in a reduction of water and chemical use. Once implemented, the system will only use water for evaporative cooling and a blowdown process that removes high mineral content water. Upon approval of the project from management, the next step is to measure out an appropriate space on the roof for the cooling tower and space in the plant for the plate and frame heat exchanger.

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
SICP GLYCOL HEATING SYSTEM	$31,580	47,713 therms 8,860,600 gallons water 104,949 lbs. water softener 234 lbs. chloride treatment chemicals	RECOMMENDED
NICP GLYCOL HEATING SYSTEM	$26,114	32,257 therms 5,990,400 gallons water 36,549 lbs. water softener 2,021 lbs. chloride treatment chemicals	RECOMMENDED
NICP AIR COMPRESSOR COOLING SYSTEM	$42,721	22,556,124 gallons water 6,904 lbs. chloride treatment chemicals	RECOMMENDED

2022 PROJECT INDEX

POLLUTION PREVENTION INTERN PROGRAM

CARBON CAPTURE

- JBS Swift Pork

CHEMICAL REDUCTION/REPLACEMENT

- Monogram Quality Foods
- Wells Enterprises, Inc.

COMPRESSED AIR

- Dee Zee, Inc.
- Polaris Industries–Indian Motorcycle

ENERGY REDUCTION

- Dee Zee, Inc.
- JBS USA, LLC
- Monogram Quality Foods
- Polaris Industries–Indian Motorcycle
- Tyson Foods, Inc.–Hillshire Brands
- Wells Enterprises, Inc.

HEAT RECOVERY

- Dee Zee, Inc.

LIGHTING

- Polaris Industries–Indian Motorcycle

PROCESS IMPROVEMENT

- Dee Zee, Inc.
- HNI Corporation
- JBS Swift Pork
- JBS USA, LLC
- Monogram Quality Foods
- Wells Enterprises, Inc.

SOLID WASTE MANAGEMENT

- HNI Corporation
- Monogram Quality Foods

WASTEWATER

- Monogram Quality Foods

WATER USE REDUCTION

- JBS USA, LLC
- Tyson Foods, Inc.–Hillshire Brands
- Wells Enterprises, Inc.

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