www.iowap2services.com

CASE SUMMARIES WRITTEN BY
2023 P2 Interns

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DIRECTOR'S NOTE

The DNR is proud to highlight the accomplishments of the 2023 intern projects completed through the DNR's Pollution Prevention (P2) Intern Program. Each year, this program, a partnership of business, government, and academia, demonstrates the Department's mission statement in action. As our mission states, "to conserve and enhance our natural resources in cooperation with individuals and organizations," this effort is accomplished with all of us working together. As the interns gain an understanding of environmental impacts and stewardship of industries in Iowa, the companies gain a new perspective and fresh ideas to boost environmental stewardship.

Companies are rising to the challenge of doing their part in using resources more efficiently. Aggressive short-term and long-term goals have been set at corporate levels for energy and water use, source reduction for solid and hazardous production waste, and emissions. Pollution Prevention Services provides technical assistance to help companies accomplish these goals with pollution prevention methodologies.

Healthy businesses are critical to the continued prosperity of Iowa communities. Year after year, the projects completed by the P2 interns continue to show that environmental improvements can significantly reduce operating expenses and improve a company's bottom line. Since 2001, host companies have reported more than $116.59 million in savings from implemented improvements. I wholeheartedly commend each of the participating companies, the top-level interns, and the Pollution Prevention Services' team for their ongoing dedication to an improved quality of life in Iowa to ensure a legacy for our future generations.

- Kayla Lyon
Director
Iowa Department of Natural Resources

TOTAL IMPLEMENTED SAVINGS 2001–2023

POLLUTION/WASTE REDUCTION & COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	6,057,113,342	gallons	$17,907,144
SPECIAL WASTE	76,148.54	tons	$1,996,538
SOLID WASTE	198,706.61	tons	$17,589,569
HAZARDOUS WASTE	10,241.61	tons	$18,702,318
MERCURY ABATED	42,817	grams	
ENERGY	512,993,872 4,119,258 23,684,103	kWh *MMBtu therms	$29,324,016 – $16,651,591
OTHER			$14,418,307
			TOTAL: $116,589,483

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

2001–2023 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
11.758	677.875	113.519	74.747	1,227.200	134.771	393.691

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
312,578.685	76,398.045	4,166.079	2,144.849	415,946.570

2023 EXECUTIVE SUMMARY

In the past year, twelve upper-level engineering students teamed with the Department of Natural Resources' (DNR) Pollution Prevention Intern Program to help companies meet their environmental objectives. Working onsite at top Iowa companies, interns identified strategies to reduce solid and hazardous waste generation, water, energy, 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. Opportunities for more than $1.2 million in annual savings were identified. Of these, projects estimated to save $379,000 annually have been implemented or are in progress.

The intern program is an extension of the Department'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 career experience. Companies benefit from having qualified talent dedicated to compiling and analyzing data and developing innovative solutions.

Most of this year's summer intern projects focused on an aspect of process improvement. To reduce generated waste, one project identified sources of product loss and another evaluated an alternative wastewater monitoring process. Other projects focused on more common targets of the intern program including compressed air efficiency, natural gas and water usage, heat recovery, integrations of a closed-loop system for heating and cooling, and source reduction of waste generation.

Fall semester intern projects include a 2022 16-week co-op project at Cambrex Charles City to identify and implement improvements to reduce water usage and an on-going 28-week project at Ajinomoto Health & Nutrition North America in Eddyville, developing digital data collection solutions to optimize operating parameters and working on long-term strategies to reduce water and energy usage at the plant.

The 2023 case summaries highlight the commitment companies are making to environmental stewardship and achieving aggressive sustainability goals.

2023 ENVIRONMENTAL SAVINGS

ACTUAL POLLUTION/WASTE REDUCTION AND COST SAVINGS FROM INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	8,192,300	gallons	$77,397
SOLID WASTE	295.44	tons	$115,932
HAZARDOUS WASTE	35.21	tons	$19,185
ENERGY	233,787 26,938 261,398	kWh **MMBtu therms	$16,008 – $108,194
OTHER			$42,000
			TOTAL: $378,716

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

NOTE:

- Air emissions and greenhouse gases shown on these pages 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.

TOTAL REPORTED FROM 2023 PROJECTS THROUGH AUGUST

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
0.029	0.966	0.183	0.097	1.338	0.533	1.690

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
400.600	186.326	10.219	2.990	766.728

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 changed in production, operations, raw material 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. When employing P2, the entire process is examined to identify how and where waste is generated and find ways to use resources more efficiently. Reducing the generation or use of hazardous materials is a key component of P2 methodologies.

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

Using one or more P2 strategies to implement environmental improvement projects almost always saves a company money in reduced utility or operating costs. The projects in this document provide an example of how quickly savings can add up when prioritizing stewardship of resources.

COMPANY TESTIMONIALS

"We have participated in the program for two years. Each project was difficult and the interns were able to overcome obstacles and provide us with actionable recommendations."

–HARLAN BUXBAUM
DEE ZEE, INC.

"This is a great program for achieving a focused project goal."

–GUY RIMBEY
NATIONAL CARWASH SOLUTIONS

"Our intern had a great drive to gather and analyze data and search for viable solutions. We now have a clearer understanding of current water usage that will help us target specific areas for water reduction."

–LAUREN MELLENE
BURKE MARKETING CORPORATION - HORMEL FOODS

POLLUTION PREVENTION: COMPANY PROJECT REQUESTS

FOR COMPANIES WISHING TO MAKE A PROJECT REQUEST

Pollution Prevention Services is currently accepting requests for 2024 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 8, 2023 to be considered for a 2024 intern placement.

Project requests are reviewed upon receipt and companies will be contacted within two weeks for review, clarification and further development, if needed. 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 2024.

Project request forms are available at www.iowap2interns.com

Please note: *Students are not trained in or qualified to assess regulatory compliance issues.*

» SUBMIT PROJECT REQUESTS TO: P2SERVICES@DNR.IOWA.GOV

Pollution Prevention Services

ASSESSMENTS

OPPORTUNITY ASSESSMENT: Site visits identify potential areas for pollution prevention.

FOCUSED ASSESSMENT: In-depth analysis of a single process or media within a facility.

THERMOGRAPHIC ASSESSMENT: Infrared cameras spot inefficiencies in structures and systems.

Our team provides a detailed report on waste reduction and pollution prevention strategies, support for implementation, and help in applying for EPA recognition programs. Areas of focus include energy efficiency, solid and hazardous waste reduction, and water conservation.

TECHNICAL SUPPORT AND RESOURCES

P2 RESOURCE LIBRARY: Access a digital library of best practices and new technologies.

TECHNICAL ASSISTANCE: Get answers to your queries in-person, over the phone, or by email.

EQUIPMENT LOAN PROGRAM: Monitoring equipment is available to support your initiatives.

P2 UNIVERSITY: Our online training portal provides interactive technical modules on various topics.

P2 INTERN PROGRAM

We hire engineering students to conduct assessments and research solutions. They establish usage baselines and quantify benefits of system improvements. Our intern program has facilitated more than $116 million in savings for companies looking to meet environmental goals while providing valuable experience for students.

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) SUPPORT

An EMS offers a structured way to manage environmental responsibilities. Our confidential, technical assistance helps with EMS development and continuous improvement.

WORKSHOPS

Our workshops and webinars facilitate the sharing of best management practices and new technologies, focusing on topics like water conservation, energy efficiency, and waste management. They provide critical insights to lower costs and reduce environmental footprints.

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.

2023 POLLUTION PREVENTION INTERNS

"The rewards of a P2 Internship are being able to start and finish a project that saves the company money and the experience of solving real-world problems."

- JACOB HINZY
Anderson Erickson Dairy - Shrink Reduction

"It was a rewarding experience that helped me grow and allowed me to build my resume for future job opportunities, for which I'm really grateful."

- ALEJANDRO LIRA
JBS Swift Pork

"One of the best aspects of this internship was the hands-on experience. I have gained confidence in my engineering skills."

- NOLAN HINRICHS
Anderson Erickson Dairy - Washout

"This internship helped me to prepare for the real world of engineering as I was able to throw myself into my project and jump into the deep end. "

- AIDAN MCDERMOTT
JBS USA, LLC

"This was an interesting internship that showed me more about expectations of an engineer. I also gained experience to help prepare for my professional career."

- CONNOR LIVENGOOD
Burke Marketing Corporation - Hormel Foods

"Through this journey, I gained valuable experience and a wealth of knowledge that will undoubtedly shape my future career aspirations."

- JONATHAN CHAN
Dee Zee, Inc.

"The P2 intern program allows for interns to identify and solve problems. Being able to independently find and solve a problem with real consequences at your site is an experience few internships can provide."

- JASON MELNICK
Ajinomoto Health & Nutrition North America, Inc.

"This internship was a great acclimation to the career world with opportunities to engage in engineering conversations at the company and with equipment vendors."

- LUIS HERNANDEZ
Yokohama TWS

"The experience of working as an engineer provided opportunities to network with staff, interact with external vendors, and increased my confidence in managing my own project."

- DALLEN HECKER
Tyson Foods Inc. - Hillshire Brands

"Effective communication helped me develop time and project management skills in a career-type setting."

- JASON CHRISTENSEN
National Carwash Solutions

"Networking with employees at all levels in a workplace environment has given me more confidence in myself, my engineering abilities, and communication skills. "

- DEJUAN ROBERSON
CJ Bio America

POLLUTION PREVENTION: STUDENT APPLICATIONS

STUDENTS! Join the P2 Intern Program in 2024!

Graduate and junior or senior-level undergraduate engineering students are encouraged to submit the following documents for consideration:

- ☐ Application Form
- ☐ Résumé
- ☐ Cover Letter
- ☐ Unofficial copy of transcripts
- ☐ List of Fall 2023 and Spring 2024 classes

Pollution Prevention Services is offering internships for 12-weeks (May 20–August 9) or co-ops for 28-weeks (May 20-November 29) in 2024.

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

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

SUBMIT APPLICATIONS TO:

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 2024.

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 20th with a week of training. Curriculum includes 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. Company staff provides resources and contacts onsite to help the intern learn the processes and assess alternatives.

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.

JASON MELNICK

SCHOOL: Iowa State University

MAJOR: Mechanical Engineering

AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.
28-WEEK COOP PROJECT

COMPANY PROFILE:

Ajinomoto is a Japanese based food and seasoning manufacturer dedicated to improved health and eating habits, with more than 34,000 employees worldwide. At its Eddyville, Iowa, facility, Ajinomoto Health & Nutrition North America, Inc. operates a single shift with more than 200 employees in three sections. Ajinomoto Food Ingredients (AFI) produces monosodium glutamate, which is used as a seasoning. Ajinomoto Heartland, Inc. (AHI) produces amino acids for animal feed, including lysine, threonine, and tryptophan, while the Technical Engineering Center United States (TECUS) focuses on research and development.

PROJECT BACKGROUND

The primary focus of this 28-week intern project at the Eddyville site is to strengthen the organizational system for tracking crucial permitting data on emission points. Better organization and collection of information and an improved interface will reduce the amount of time required to manually perform tracking. Additionally, having the data electronically will provide more accurate, real-time data, enabling better analysis. Ajinomoto requested that the first half of the project focus on providing more comprehensive data by inputting data from the process control systems into its softwaretracking system. In the latter half of the project, the intern will use the gathered data to identify and assess improvement opportunities to reduce utility usage.

INCENTIVES TO CHANGE

On a global level, Ajinomoto is committed to improving human health through better nutrition and promoting environmental stewardship. Locally, the company strives to be a productive and responsible neighbor, contributing to a healthy community. Ajinomoto has pledged to reduce its environmental impact 50 percent by 2030. In particular, reducing utility usage will result in significant financial benefits and improved environmental performance.

PROJECTS

Water Softening: Makeup water is required for any cooling tower system. The AHI cooling tower system uses water that could be improved through water softening. Softening would result in a reduction of calcium scale build up throughout the process and also improve heat transfer efficiency. Scale build up causes a loss of efficiency and can even shutdown a process. Thus, the heat exchangers need frequent cleaning to prevent a buildup of scale. Softening the water would increase the cycles of concentration in the cooling towers, allowing for decreased water usage. Data is being collected to model the energy loss from AHI's heat exchangers and calculate projected savings.

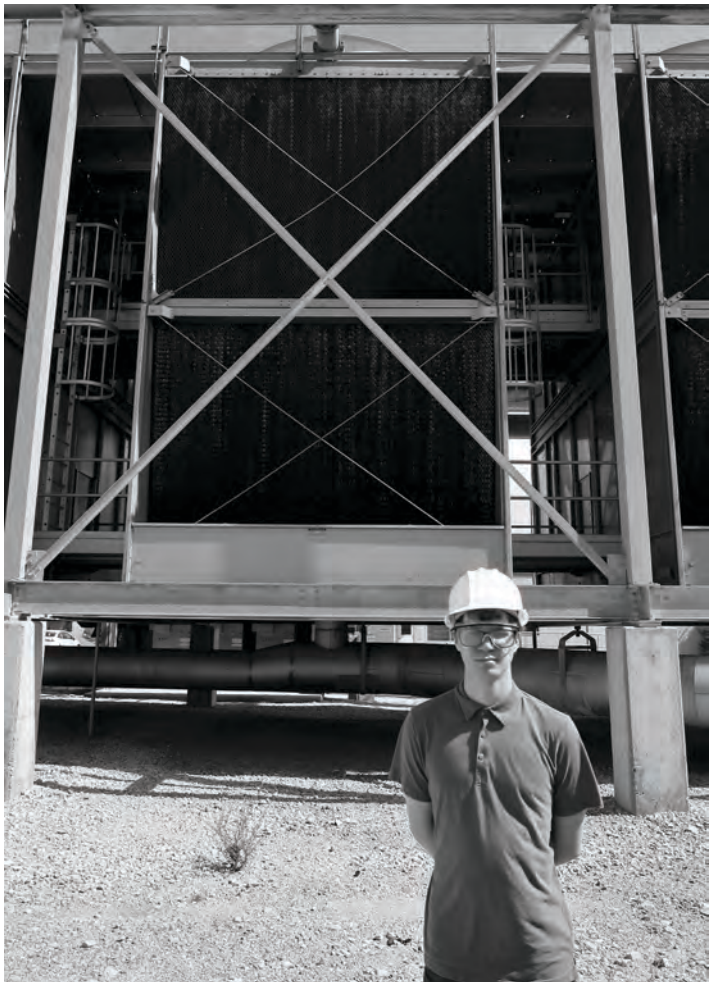
Emission Point Data Collection: Ajinomoto operates under permits that list emission limits. By ensuring ideal conditions are maintained, particulate emissions will be below permitted limits and ensure pollution prevention. Data for this equipment, which is stored in the data historian software PI Vision, can be imported and organized into Microsoft Excel for analysis. Proper monitoring and data collection of these systems reduces environmental impact and assists Ajinomoto in meeting its air permit emission standards. Excel sheets have been created to store the desired information. This project is projected to be expanded to other equipment in the future.

Compressed Air Leak Repairs: Ajinomoto makes extensive use of compressed air in a variety of equipment. Although essential to the process, compressed air is costly and requires a large amount of electricity to produce. Throughout Ajinomoto's factories, there are hundreds of points where compressed air leaks may be present. Identifying and fixing air leaks will lead to large savings and reduced environmental impact. Currently, a compressed air audit is planned for October during the biannual shutdown.

Rainwater Collection: Ajinomoto has a storm drain system that sends rainwater to various outfalls where the water is released into a creek. This water could be collected and used in various processes throughout the site where water is needed. Although the rainwater may need treatment, it is likely more cost effective to filter and treat collected rainwater than well water. A proper water collection system can reduce the amount of water that is needed from wells, reducing utility usage and environmental impact. Currently, the total area and runoff coefficients of each outfall are being used to estimate potential savings.

Next Steps: During the last 16 weeks of the internship, data will continue to be collected to determine economic viability of the proposed projects. The largest focus will be placed on the water softening project, due to its large scale and great opportunities for cost savings and environmental impact reduction. Investigations into other potential projects will also be performed.

A final case summary for this project will be posted on the Pollution Prevention Intern Program website at www.iowap2interns.com in January 2024.



JACOB HINZY

SCHOOL: Iowa State University

MAJOR: Mechanical Engineering

ANDERSON ERICKSON DAIRY - SHRINK REDUCTION

DES MOINES

COMPANY PROFILE:

Anderson Erickson (AE) Dairy, located in Des Moines, Iowa, is a renowned dairy company that has been providing premium dairy products since its inception. With a rich history dating back to 1930, AE Dairy has become a household name in the region, known for its commitment to quality and freshness. The company prides itself on its locally sourced milk from Iowa farms, ensuring that its products are of the highest standards. With approximately 375 employees working at some capacity 24 hours per day, AE Dairy processes a variety of milk products, sour cream dips, yogurts, ice cream mixes, cottage cheeses, and various seasonal products like eggnog, orange juice, and lemonade.

PROJECT BACKGROUND

At AE Dairy, the intern focused on assessing and recommending opportunities for improvement within the production process. On average, AE Dairy receives three quarters of a million pounds of milk a day which is then processed, packaged, and stored in a cooler. The difference between the amount of raw milk received versus the amount of finished milk product to the cooler is tracked in pounds as milk loss. The company sought to identify the points of milk loss within the production process and develop solutions.

INCENTIVES TO CHANGE

AE Dairy is highly motivated to reduce milk loss in its production process. By minimizing waste, it not only demonstrates its commitment to sustainability and environmental responsibility but also improves its overall operational efficiency. Through the implementation of advanced technologies and continuous process optimization, AE Dairy aims to ensure that every drop of milk is maximized for production, reducing costs and contributing to a more sustainable dairy industry. This proactive approach not only benefits the company's bottom line but also aligns with its dedication to delivering top-quality dairy products while minimizing its environmental footprint.

RESULTS:

An in-depth analysis identified the main loss points within the production process. This baseline assessment provided documentation on exactly where and what milk loss occurred, and why the loss was occurring. Loss points identified by the intern included points of product changeover and product line flushing, overfill of milk jugs, and improper filler bowl height. In the recommendations that follow, solutions were developed for reducing milk loss in some of these identified loss points.

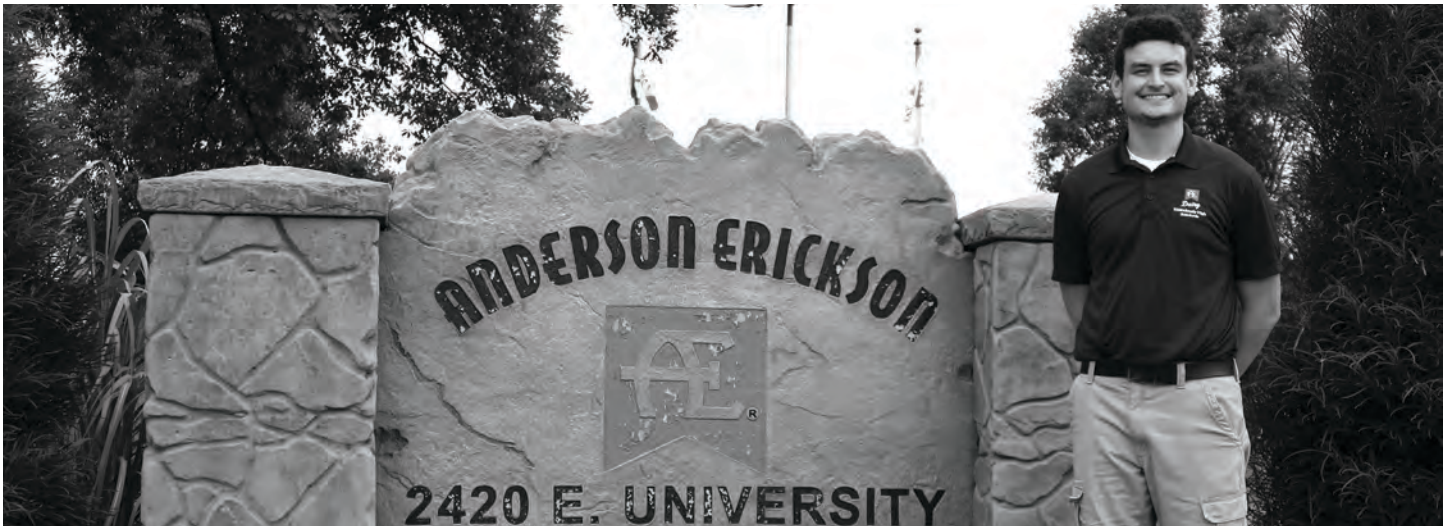
Install Air Blows: When switching butterfat percentages of milk on the pasteurizing side of production, the first step is clearing the prior butterfat blend from the product line before starting a new product. A positive displacement pump uses water to clear the remaining milk in the line and pumps this product/water mix to a drain. Installing air blowers that use sterile compressed air to clear the product lines will allow for the recovery of the remaining milk in the lines. Installation entails clamping the air blow and HEPA filter to a product line and updating programming controls to insure a thorough clearing of the line. Maintenance staff and the on-site electrician plan to have the air blowers on pasteurizing lines operating by September 2023.

Update Purge Cycle of Carton Filler: When starting a new product on the carton filler, it is necessary to clean the filler bowl and valves with a food-safe cleaning solution. After the cleaning cycle, the operator will purge all the spent cleaning solution from the filler, and then run another purge through the valves using product until the lines are deemed clear.

By testing the total solids and butterfat of the product at each purge cycle, it was determined that the product purge cycles can be reduced by at least one cycle, reducing the amount of milk loss generated by this process. The plant is in the process of implementing a one cycle reduction. Further testing on subsequent reductions will be required before full implementation can occur.

Recovery Tank for Half Pint Fillers: When switching between products on the filler machines, it is necessary to clear the finished product out of the line by pumping in the new product. A mixture of both products will be purged from the filler and collected in cans to be reprocessed. Any part of the product mixture that is not collected will be lost. This collection process takes the operator 20 minutes of production time and requires lifting 300 pounds. Alternatively, the clean-in-place tank below the fillers can be retrofitted to become a recovery tank to capture this product mixture and pump it directly to the reprocess tank. This change will save 150,000 pounds of milk annually, and reduce operator time spent manually recovering milk from the lines. It will also make the recovery process much easier on the operators by eliminating the heavy lifting requirements. To implement this recommendation, 3D sketches of the lines and retrofitting will be required.

Blow Mold Preventative Maintenance: AE Dairy produces its own gallon and half-gallon milk jugs, creating millions of plastic jugs per year with extrusion blow mold machines. Extrusion blow mold processes can be temperamental. Close monitoring of the molds, plastic mixes, and heating and cooling of the machines is required to ensure jugs are produced within the target weight tolerance. If a jug is underweight, its side walls will expand, or bloat, when filled with milk, resulting in overfilling of the jug. To ensure consistent fill volumes, additional preventative maintenance measures and inspections can be implemented to ensure optimal jug weights. Conducting weekly blow mold inspections and checks of the equipment's heating and hydraulic systems will ensure optimal performance. It will also increase the lifespan of the equipment and minimize downtime. The maintenance team will work with the operators to create a plan of daily and weekly tasks to improve blow mold operations.



ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL AIR BLOWS	$88,222	489,492 lbs. milk	IMPLEMENTED
UPDATE PURGE CYCLE OF CARTON FILLER	$20,800	4,160 gallons dairy product	IN PROGRESS
RECOVERY TANK FOR HALF PINT FILLERS	$33,000	149,806 lbs. milk labor	RECOMMENDED
BLOW MOLD PREVENTATIVE MAINTENANCE	$24,186	134,193 lbs. milk	RECOMMENDED

NOLAN HINRICHS

SCHOOL: The University of Iowa

MAJOR: Mechanical Engineering

ANDERSON ERICKSON DAIRY - WASHOUT

COMPANY PROFILE:

Anderson Erickson (AE) Dairy is a family-owned company that has been dedicated to producing high-quality dairy products since 1930. AE is headquartered in Des Moines, Iowa, where it has been producing products in the same facility since 1938. The plant operates three shifts, 24 hours a day, seven days a week with approximately 375 employees. AE's quality products are in numerous grocery stores across Iowa and the Kansas City area, with a select presence in neighboring states.

PROJECT BACKGROUND

Any time production changes over to a new product, all equipment must be thoroughly cleaned and sanitized. Washout processes and cleaning procedures constitute the majority of water usage at the plant. Nearly all production equipment is cleaned using a clean-in-place (CIP) program. Commonly used in food manufacturing facilities, CIP programs are automated, multi-phase cleaning cycles that don't require the disassembly of equipment. After a washout baseline was created, areas of opportunity were identified to optimize washout water consumption and associated costs. Additionally, water baseline work was completed to begin mapping water usage in non-CIP focused applications.

INCENTIVES TO CHANGE

AE Dairy continues to actively seek ways to enhance the quality of its products while minimizing its environmental footprint. As part of this commitment, AE is diligently working towards achieving carbon neutrality by adopting renewable energy sources and employing carbon-neutral brown boards for milk containers. As AE continues to strive toward sustainability, it has targeted the optimization of production water use as a key next step.

RESULTS

The intern started with establishing a baseline of water usage at the plant. Approximately 80 percent of the water consumed by AE Dairy was found to be used for sanitation. Sanitation includes product rinses, facility cleaning, and CIP programs. The CIP programs can be divided into four major categories: tanks, lines, fillers, and pasteurizers. The CIP programs dedicated to cleaning tanks and lines make up 55 percent of the total water consumption, while the fillers and pasteurizers use 4 percent and 10 percent respectively. These baseline percentages confirmed the value of further analyzing the CIP systems for water use efficiencies.

Installation of Turbidity Meters: The standard CIP program consists of four timed stages. First, freshwater is flushed through the system to remove any remaining product. Then a wash solution is recirculated through the system to kill bacteria and remove protein buildups. Freshwater is then flushed through the system again to remove the wash solution from the system and lastly a sanitizing solution is used. Sampling was completed on ten CIP programs to test for the presence of any product remaining in the rinse water. The results of this sampling verified that most of the product is fully removed before the end of the first pre-rinse timed cycle, meaning excess water is being used.

Turbidity sensors measure the amount of suspended particles within a fluid. Using turbidity sensors to control rinse times could reduce the amount of water used for the pre-rinse by automatically ending the rinse cycle when all remaining milk product is removed from the rinse stream.

A pilot turbidity meter was installed and tested to validate this recommendation. It was determined that the water needed for the pre-rinse could be reduced by 14 percent and still maintain the quality standards of the cleaning process. The pilot testing was still in progress at the end of the internship. When approved, turbidity meters could be installed on all CIP skids for plant-wide savings.

Case Wash Tank Water Reuse: In each CIP program, fresh post-rinse water is pumped through the system following the wash cycle before a new milk product run begins. Some of this post-rinse water is then sent to a tank to wash the plastic dairy crates used for packaging and distribution. However, the crate wash does not use all of the post-rinse water and the excess is diverted to the drain. The excess post-rinse water could be piped back to select CIP skids and used as pre-rinse water. Pre-rinse water is not required to be fresh water from the city because it precedes the wash solution cycles that perform the sanitization process. If this recommendation is approved, piping installation for the targeted CIP skids would be scheduled to minimize production downtime.

Tank Sprayer Upgrade: A large number of tanks are used throughout production to hold and store product. As part of the CIP process, most tanks utilize a static spray ball to spray down the interior of the tank. Made of stainless steel, these spray balls have holes drilled into the surface and spray water in all directions. The spray balls operate using high flow rates and long rinse times in order to effectively clean the tank.

Rotary spray heads operate by spraying a flat, fan-shaped jet while the entire sprayer rotates, providing 360-degree coverage. Due to the mechanical action of the moving jets, rotary spray heads can provide faster, more efficient coverage than the spray balls, using up to 30 percent less water. The most effective implementation process is to install the rotary spray heads along with the turbidity meters so the rinse cycles can be automatically updated as the new tank sprayers are installed. Two rotary spray heads have been purchased and are currently being piloted in one of AE's batch tanks. If testing is successful AE will consider plant-wide replacement.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALLATION OF TURBIDITY METERS	$16,250	1,417,000 gallons	RECOMMENDED
CASE WASH TANK WATER REUSE	$13,431	1,171,000 gallons	RECOMMENDED
TANK SPRAYER UPGRADE	$28,627	2,393,608 gallons	RECOMMENDED

CONNOR LIVENGOOD

SCHOOL: Iowa State University

MAJOR: Chemical Engineering

BURKE MARKETING CORPORATION - HORMEL FOODS

COMPANY PROFILE:

Burke Marketing Corporation, a subsidiary of Hormel Foods, is located in Nevada, Iowa. The facility produces fully cooked meat products for a variety of customers. More than 1,300 different recipes are used on a frequent basis to meet customer needs. Burke has been in the pizza industry for 50 years with 40 of those years in the topping industry. Burke employs approximately 500 members across two production shifts and a sanitation shift, running an average of five days a week.

PROJECT BACKGROUND

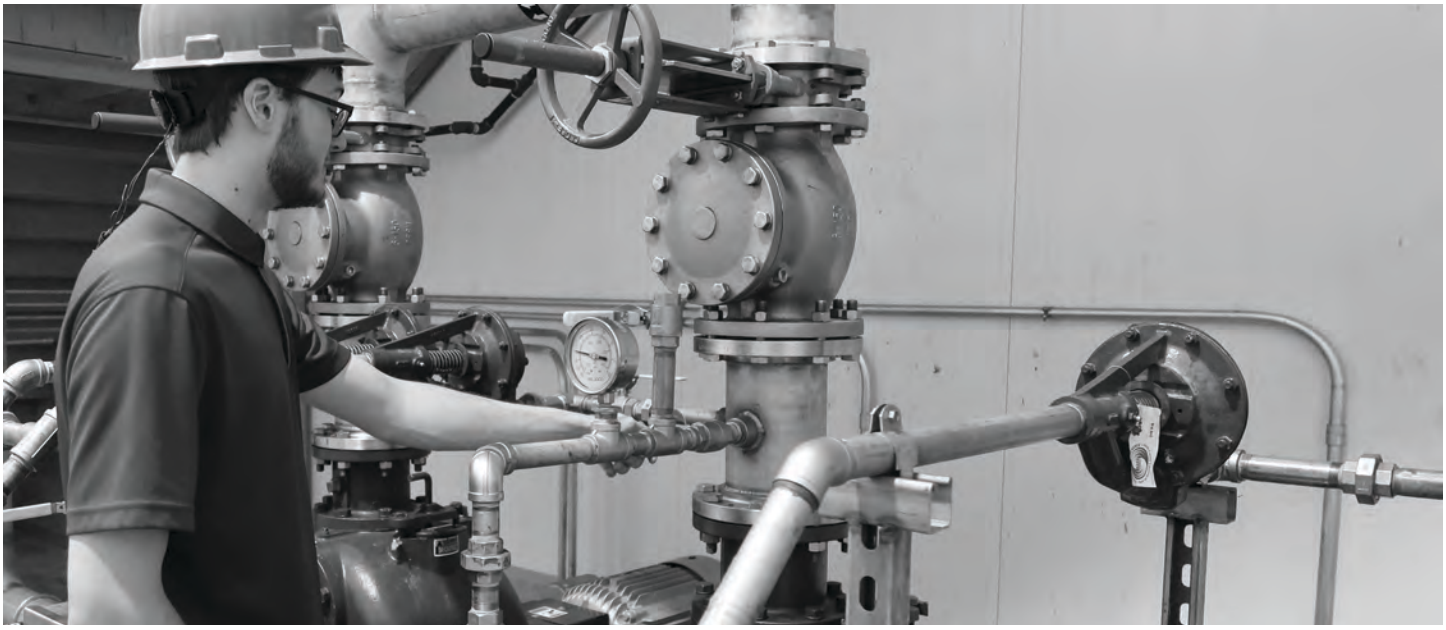
The intern analyzed both water consumption and wastewater leaving the facility. A baseline was created to gain an understanding of where water is being used throughout the plant. This baseline was used to establish points of interest for further investigation. This project focused on reducing water consumption while not hindering vital operations, like sanitation. A secondary objective was to assess the pretreatment facility and explore methods to improve the quality of the effluent being sent to the City of Nevada wastewater treatment plant.

INCENTIVES TO CHANGE

Hormel is committed to continuous improvement and is working toward achieving 20 environmental and sustainability goals by 2030, called the 20 by 30 challenge. Goals are pursued and monitored through a company-wide Environmental Management System (EMS). In 2019, Burke greatly increased production by doubling its plant size. To offset environmental impacts from the expansion, Burke is aiming to annually reduce the amount of water used in production and sanitation by two percent. As a second goal for the 20 by 30 challenge, Burke is targeting to reduce organic waste by 10 percent.

RESULTS

Piping Insulation: A heat exchanger uses steam to reheat a grease water solution to a desired temperature, keeping the grease from solidifying before it is separated from the water and made into a by-product. A long pipe run transports the grease water from the cooking process to the heat exchanger. The ambient air along the uninsulated pipe run causes the grease water to slowly lose temperature so that it requires reheating. Adding insulation to the pipe would help maintain the temperature of the grease water and increase flow efficiency through the pipe. A one-inch insulation thickness was recommended by the vendor based on insulation efficiency ratings and the cost of diminishing returns. This recommendation is also based on the building management system and data from temperature readings on the production floor. By insulating the pipe run, less steam

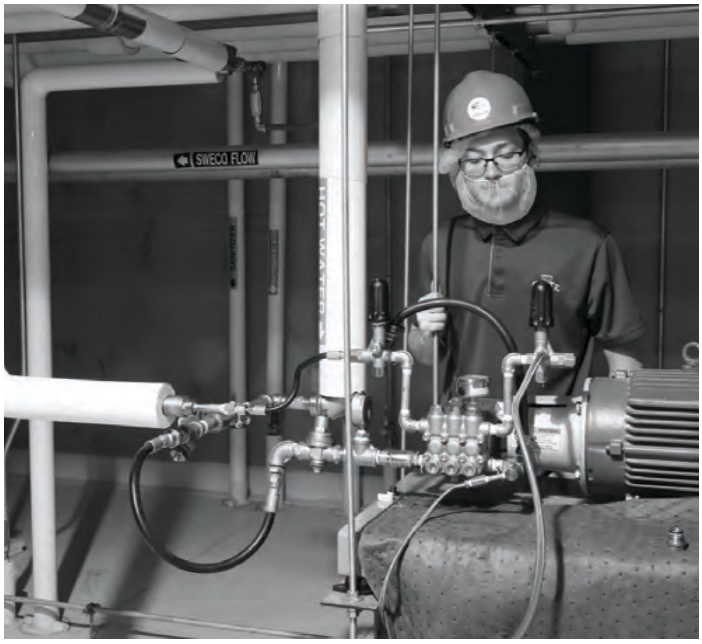


would need to be produced by the boilers feeding the heat exchanger, reducing both water and natural gas usage. The insulation could be installed with no effect to the production schedule. Once approved for funding, the company could begin installing the piping insulation.

Water Audit: During a plant shut-down, the intern conducted a water audit and measured any identified leaks. Both the nozzles and valves on the hose stations were found to have slow leaks. The nozzles are regulated with a ball valve that may lead to the nozzles not fully shutting off. A spray gun nozzle system is recommended to reduce the risk of water loss and is currently being tested for its viability as a replacement. The valves found leaking were equipped with a backflow preventer that had started to corrode over time. Burke has started using a different valve type in other parts of the plant that is working well and does not leak. The intern recommends that the site change the leaking valves to the new type of valve. Installations of both nozzles and valves could take place when production is shut down. A preventative maintenance plan for the nozzles and valves would help reduce the chances of future leaks and address any identified leaks in a timely fashion in accordance with the site's environmental management system.

To help identify leaks in the future, it is recommended that the company add a preventative water audit with the currently established compressed air audit. This would aid in keeping the system operating efficiently and reduce water loss. The intern observed that some equipment was left running during nonproduction days. A quick walk through, by either the sanitation or maintenance crew, to turn off any equipment left running at the end of each production shift is recommended. This would result in a no cost remedy and reduce water usage. Both of these minor changes work toward a common goal of eliminating non-essential water consumption.

CBOD/TKN Cleaner: Soluble carbonaceous biochemical oxygen demand (CBOD) and total Kjeldahl nitrogen (TKN) are significant contributors to the plant's wastewater contaminant load. The contaminants originate from the raw material handling and cooking processes. Under current operations, neither can be fully eliminated at the source or treated within the plant's pretreatment system. A process has been identified that uses mechanical and biological systems to treat these two compounds and reduce overall treatment costs. It is recommended to pilot this process to confirm the viability and specifications of the system. The system is self-maintained and would have very little impact on the standard operating procedures for the wastewater operators at the plant.



ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
PIPING INSULATION	$40,560	1,019,128 gallons 24,965 therms	RECOMMENDED
WATER AUDIT	$17,344	777,380 gallons 5,182 therms	IN PROGRESS
CBOD/TKN CLEANER	$153,568	224.14 tons of CBOD 18.84 tons of TKN	RECOMMENDED

NATHAN SMITH

SCHOOL: Iowa State University

MAJOR: Chemical Engineering

CAMBREX CHARLES CITY

2022 FALL COOP PROJECT

COMPANY PROFILE:

Cambrex, founded in 1981, is a leading global contract development and manufacturing organization that delivers drug substance, drug product, and analytical services across the entire drug life cycle. The company has a presence in sixteen locations globally and is one of the world's leading API producers, applying their technologies and expertise to meet the accelerated market demand for small molecule therapeutics. Cambrex Charles City, Inc. (CCC) manufacturers a wide range of active pharmaceutical ingredients (APIs), including highly potent compounds and controlled substances. The facility is home to more than 400 employees with multiple commercial Current Good Manufacturing Practices (cGMP) plants for large-scale pharmaceutical production, while also offering resources for small- and mid-scale development and manufacturing.

PROJECT BACKGROUND

Any time production changes over to a new product, all equipment must be thoroughly cleaned and sanitized. Washout processes and cleaning procedures constitute the majority of water usage at the plant. Nearly all production equipment is cleaned using a clean-in-place (CIP) program. Commonly used in food manufacturing facilities, CIP programs are automated, multi-phase cleaning cycles that don't require the disassembly of equipment. After a washout baseline was created, areas of opportunity were identified to optimize washout water consumption and associated costs. Additionally, water baseline work was completed to begin mapping water usage in non-CIP focused applications.

INCENTIVES TO CHANGE

Cambrex is dedicated to continuous improvement in environmental performance and strives to use resources efficiently and minimize waste. Each Cambrex facility has programs committed to continuous improvement and advancing sustainability. As CCC continues to expand operations, reducing water usage is essential to continued operational efficiency. This year's partnership with the Iowa Department of Natural Resources' Pollution Prevention Intern program supports the company's commitment to operational excellence and sustainability, a commitment formalized by Cambrex's membership in the Society of Chemical Manufacturers and Affiliates (SOCMA), and subscription to the environmental management system ChemStewards®.

RESULTS

CIP Nozzles: Chemical ingredients used in the various reactions at CCC are contained in 55-gallon barrels. After the barrels are emptied of their contents, the barrels are triple-rinsed and crushed for disposal. The current triple-rinse process utilizes a manifold with a large orifice. Using a bucket and stopwatch, the intern measured the flow rate of the current rinse and compared it to alternative nozzles that operated at a lower flow rate. After comparing efficacy and cost savings, the most effective nozzle was recommended based on rinsing coverage and impact. A quote has been obtained from the vendor and the nozzles have been approved for order.

Water Audit: In-depth water audits allow facilities to collect the usage data they need to make informed decisions about optimizing water use at the process and equipment level. CCC had high level facility water data available but lacked specific usage information at the work-center level.

The intern completed a work-center-specific city water usage audit and then developed historical water balances for three prior years. Having access to this new data has already allowed CCC to identify new water conservation opportunities, and feasible improvements will be developed and documented moving forward.

Direct Steam Injector PM: CCC has an onsite wastewater treatment plant. During the cooler months, a direct steam injection (DSI) system keeps the influent heated to a temperature where the microbiological organisms can function efficiently. DSI heaters benefit from preventative maintenance (PM) plans, which keep them operating efficiently by preventing excessive steam use and relieving stress on the boiler. With a new DSI heater being installed in 2022, the intern developed a detailed PM plan to maintain optimum efficiency of the tube. Preventative maintenance on the DSI will be done twice a year, before startup and after shutdown. A draft of the PM plan was submitted to the reliability engineer for review and finalization before being entered into the company's PM system.

Steam Survey: Conducting a steam survey can pinpoint failed steam traps that are either blowing through steam or holding condensate. Replacing these failed traps increases steam system productivity and safety, increases condensate return, and reduces the demand for boiler makeup water and associated treatment chemicals.

The intern used an ultrasonic leak detector to conduct a steam survey of the plant and found that approximately 18 percent of the active traps had failed. The identified leaks and associated savings have been documented and submitted to plant maintenance staff for repair. In addition, CCC will be conducting regular steam surveys as part of their PM program, with the next survey planned for 2023.

Insulation: Insulation improves steam quality, reduces heat loss, and conserves energy and associated emissions. Using a non-contact thermometer, the intern conducted an insulation survey to measure exposed pipes and surfaces. Location details were recorded for any surface temperature above 120 degrees Fahrenheit. Approximately 150 feet of pipe and eight valves were missing insulation. Since most of the insulation had been removed for maintenance access, the intern acquired a quote for removable insulation, and regular surveys of the insulation will be added to the company's PM program for the steam system. This may be done in conjunction with the steam survey in 2023.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
CIP NOZZLES	$6,588	2,027,188 gallons water	IN PROGRESS
WATER AUDIT	$25,200	–	IMPLEMENTED
DIRECT STEAM INJECTOR PM	$40,209	764,933 gallons water 76,172 therms 11,362 lbs. HCL 11,654 lbs. caustic 90 gallons of treatment chemicals	IN PROGRESS
STEAM SURVEY	$78,582	1,494,878 gallons water 148,859 therms 22,216 lbs. HCL 22,776 lbs. caustic 176 gallons of treatment chemicals	IN PROGRESS
INSULATION	$5,436	13,258 therms	RECOMMENDED

CJ BIO AMERICA

FORT DODGE

DEJUAN ROBERSON

SCHOOL: Iowa State University

MAJOR: Chemical Engineering

COMPANY PROFILE:

CJ Biotechnologies is a global company with 11 facilities in six countries. The company produces food grade and feed grade bioproducts for human and animal consumption. Two feed grade essential amino acids, lysine and threonine, are manufactured at the CJ Bio America refinery in Fort Dodge, Iowa, for use in swine and poultry diets. This facility operates continuously 24 hours per day, seven days per week with approximately 250 employees.

PROJECT BACKGROUND

Lysine is produced at the Fort Dodge facility using an advanced microbial fermentation and refinery process. It is critical to CJ Bio America to ensure that it does not experience lysine product loss in the production process. To closely monitor production integrity and avoid leaks, the company performs regular sampling and testing of its high solution broth (HSB) throughout the day. Currently, a high-performance liquid chromatography (HPLC) machine is used to conduct this testing. An HPLC test takes 90 minutes to run, so if the results demonstrate a loss of lysine product, significant operations time is lost before operators become aware of it.

INCENTIVES TO CHANGE

Environmental stewardship is a corporate priority for CJ Bio America with an aim to be carbon neutral by 2050. To accomplish this mission, it seeks to implement continuous improvement strategies in all aspects of its operations to meet midterm and long-term environmental goals.

The HPLC test is highly effective but generates a waste that is classified as hazardous and requires special handling and costly disposal. In assessing hazardous waste generation at the Fort Dodge refinery, CJ Bio sought to identify a viable testing option with a reduced environmental impact.

RESULTS

Replace HPLC with a TOC Analyzer: A total organic carbon (TOC) analyzer with a 20-minute run time could be a viable option to monitor for lysine loss. The shorter turnaround time represents a gain of 70 minutes of labor time for each test run and also represents 70 minutes of product recovery value in the case of a loss. The intern was tasked with comparing the quality and accuracy of the TOC results with the HPLC outcomes and adjusting set-points to determine the viability of the TOC as an alternative testing method. To successfully compare the lysine testing performance of the TOC with the HPLC, a strict sampling and testing protocol was followed. Comparison testing was undertaken in three phases.

Phase I: The intern spent the first two weeks of the project in the quality control lab, gaining training and experience with the HPLC. By becoming familiar with the equipment manuals and standard operation procedures (SOPs) for the machine, the intern acquired an understanding of how the testing happens within the machine. Additional training and shadowing of lab employees further prepared the intern for collecting, prepping, and testing the HSB samples from the refinery.

Phase II: The intern went through a similar process to become familiar with the operation and testing procedures of the TOC analyzer. From there, the intern took daily samples prepared by quality control staff and conducted tests with the TOC analyzer. Results were used to adjust the settings of the TOC analyzer until it was producing test results that were consistent with the HPLC.

Phase III: In phase III, each of the daily HSB samples were tested, first on the HPLC and then on the TOC analyzer. The data from both tests was then logged onto a spreadsheet to generate a correlation equation. Increasing the data set over time, the goal of the correlation equation was to translate the test result data from the TOC analyzer into a comparable output with the HPLC to verify accuracy and consistency of the potential alternative testing method.

Results: The intern tested more than 350 samples on both the HPLC and the TOC over the course of the project. The results of the testing thus far have yielded a correlation equation that is able to predict the HPLC test reading from the TOC test result with a promising degree of accuracy (good R2 value). Additional testing points will be needed to further increase the R2 value and refine the correlation equation. CJ Bio staff will continue testing until they reach the desired R2 value, which will provide the verification needed to seek approval for adopting the alternative testing process.

When the TOC testing process is fully implemented for lysine testing by CJ Bio, the impacts to the plant's hazardous waste generation and labor savings would be significant. In addition to reducing hazardous waste generated at the plant, the amount of time needed to run sampling tests for lysine could be reduced considerably.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
REPLACE HPLC WITH A TOC ANALYZER	$57,763	1 lb. octane sulfonic acid 40 lbs. potassium phosphate monobasic 0.98 lbs. phosphoric acid 25.15 lbs. acetonitrile 25.34 lbs. methanol 1 lb potassium hydroxide 1 lb. boric acid 1 lb. phthaldialdehyde 19.68 lbs. 2-mercaptoethanol 1 lb. brij 35	RECOMMENDED

JONATHAN CHAN

SCHOOL: Iowa State University

MAJOR: Mechanical Engineering

DEE ZEE, INC.

COMPANY PROFILE:

Dee Zee, Inc. is a premier truck accessories manufacturer, known as the world's largest manufacturer of running boards and side steps. The company is headquartered in Des Moines, Iowa, with seven buildings, comprising more than one million square feet, dedicated to manufacturing, packaging, warehousing, and shipping. With approximately 1,000 employees, Dee Zee serves large sectors of the automotive industry as an Original Equipment Manufacturer (OEM) and also supplies products to the retail consumer sector.

PROJECT BACKGROUND

The intern was tasked with analyzing energy consumption and associated costs in automation systems and establishing a baseline to prioritize improvement opportunities. This project primarily focused on reducing energy consumption in automated cells and utilities at the Broadway plant. The intern conducted feasibility studies and assessments by evaluating controls, set-points, occupancy and run-times, and motor efficiencies. The intern also explored improvement opportunities in the heating, ventilation, and air conditioning (HVAC) and compressed air systems.

INCENTIVES TO CHANGE

Dee Zee is committed to environmental sustainability, integrating LEAN practices, source reduction, and recycling efforts throughout its operations. As an ISO 14001 certified company, Dee Zee uses vendors certified by the Sustainable Forestry Initiative to meet their paper and cardboard packaging requirements. Through collaborative efforts from their sustainability team, they establish and pursue sustainability initiatives and projects, effectively steering Dee Zee towards achieving its environmental objectives. This year's project to reduce energy consumption and associated costs aligns with Dee Zee's ongoing commitment to continuous environmental improvement.

RESULTS

Install Energy Meters: Energy usage is currently measured using a single energy meter located outside the plant. More accurate data of energy usage could be achieved by installing in-line energy meters to track current status in each automated cell. The energy meters can be installed on the main power panel boxes which serve as the primary power source to ensure a more accurate measurement of the current flow and track past energy consumption, allowing an energy baseline to be established. Pairing the system to Building Manager Online, a web-based software package with a beneficial data logging feature, would allow users to quickly access data, generate data-based reports and plot charts. One meter was set up for testing purposes and in addition to demonstrating the benefits of monitoring the energy data, the testing provided clarity of the desired features for additional meters. The intern used the information from the test meter to recommend meters to be purchased and installed for comprehensive data logging from all the automated cells within the plant.

Repair Compressed Air Leaks: Compressed air serves as a vital energy source across Dee Zee's production process, supplying air to cooling systems, hand tools, and various pneumatic equipment. Air leaks were identified by the intern using an ultrasonic leak detector. Leaks in the compressed air system make the compressors work above their optimal setpoint, resulting in unnecessary energy consumption. The majority of leaks were found in connection points between the air drop down lines and the fittings of the air wands. Teflon tape and new fitting connectors can be used to seal the threading where the leaks are occurring. Proper handling of hand tools can prevent damages to the fittings. Leak maintenance and inspections can be done in house during off shift hours by the maintenance team.

Automated Cells Shut Off: The automated cells at the Broadway plant currently remain powered on, even when not in use, resulting in unnecessary energy usage. Powering down automated cells when not in operation can lead to substantial savings in both cost and energy. The cells generate a lot of heat, which adversely affects the surrounding temperature. Overheating not only damages components and causes wear and tear but also results in unexpected downtime. By shutting off the cells, the heat output can be reduced and equipment can cool down, preventing cooling systems from overworking and overheating. With lower heat generation, the cooling systems may require less energy, and have lower maintenance needs. This would result in cost savings and overall improvement in system efficiency. Significant energy could be saved by disabling the lasers, drives, robots, and light sources while the machine is idle. The robots must be set at rest in their initial cycle position through the controllers before powering down to avoid disrupting the cycle orientation. By powering down the automated cells, Dee Zee could prevent downtime, reduce idling cost and decrease energy consumption.

Preventative Maintenance: Preventative maintenance for the automated cells can eliminate unexpected downtime and unnecessary energy usage. Daily cleaning can help maintain the optimal operating conditions of the automated machines by reducing the amount of dust and debris in and around the system. Weekly maintenance inspections can help prevent wear in the system's equipment, including sensors, motors, and cooling systems. Regular maintenance facilitates better heat dissipation and proper airflow, as blocked air vents, clogged ducts, or dirty filters force HVAC systems to work harder, consuming more energy. By training workers to clean equipment and workspaces, energy needs and production downtime can be reduced.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL ENERGY METERS	$10,129	144,700 kWh	IN PROGRESS
REPAIR COMPRESSED AIR LEAKS	$5,719	81,699 kWh	RECOMMENDED
AUTOMATED CELLS SHUT OFF	$37,992	541,742 kWh	RECOMMENDED
PREVENTATIVE MAINTENANCE	$31,653	452,188 kWh	RECOMMENDED

ALEJANDRO LIRA

SCHOOL: The University of Iowa
MAJOR: Chemical Engineering
MINOR: Chemistry, Business

JBS SWIFT PORK

OTTUMWA

COMPANY PROFILE:

JBS USA, LLC is one of the world's largest food companies. Founded in 1953, JBS has built a robust supply chain network around the globe, allowing it to obtain raw materials from different regions and achieve an efficient distribution of its product. One of the more prominent branches of this network is the JBS pork facility in Ottumwa, Iowa. This facility is known for its large pork processing and distribution operations, processing more than 21,000 hogs per day. The Ottumwa facility operates three shifts and employs more than 2,000 workers.

PROJECT BACKGROUND

Large equipment at the plant such as air compressors, heavy equipment motors, and boilers generate a significant amount of heat. With three shifts, this equipment is constantly running. The project's main focus was to assess heat recovery and reuse opportunities throughout the plant. The intern evaluated ways to supply additional heat to the plant during the colder months of the year from other waste heat outputs such as heat exchangers, compressors, and cooling systems.

INCENTIVES TO CHANGE

JBS USA puts an emphasis on sustainable practices to reduce its environmental footprint and is pursuing a significant list of goals, using 2019 as a baseline. Its goals include reducing greenhouse gases and emissions 30 percent by 2030; and reaching 100 percent renewable electricity, and lowering water usage 15 percent by 2040. The company is investing $100 million in research and development projects, assisting the efforts of its producers and suppliers to also reduce emissions. Finally, JBS has set a goal to reach net-zero greenhouse gas emissions by 2040, being the first meat and poultry company to do so.

RESULTS

Double Pipe Heat Exchanger & Unit Heater: The blood dryer in the blood room is currently sending blast-air at 165°F into an air scrubber located in the rendering department. The implementation of a double pipe heat exchanger would allow for the reduction of the blast-air's temperature from 165° to 122°F. By pumping recycled water from the cooler or chillers through an outer 24-inch pipe that surrounds the core pipe, the scrubber chemicals would work more effectively. Following the heat exchanger, this hot water then could be pumped and redirected to a unit heater, located in the barns, to provide additional heating. Further research may be needed to determine the optimal area to place this heating unit.

Shell and Tube Heat Exchanger: The Butina stunners currently operate by using a large amount of carbon dioxide that is heated from liquid to a gas state with an electric heater. The current electric cost can be avoided by utilizing excess 140°F water that occurs in the production process. Installation of the heat exchanger and the necessary piping to deliver 140°F water to the heat exchanger could be installed by JBS maintenance staff. It is also recommended to leave the electric heater in place to act as an alternative route for carbon dioxide in the scenario where 140°F water cannot be delivered due to an unforeseen event. Once quotes are approved by management, maintenance can proceed with the implementation of this recommendation.

Air Source Heat Pump/CO_2 Heat Recovery: An air source heat pump can both heat and cool the intake river water that JBS uses for its internal operations. During the winter, air can be taken in and compressed in order to increase its temperature and pressure. The hot air could then be used to increase water temperature. During the summer, intake air can be cooled via a reverse valve in the air source heat pump that would decrease both the air's pressure and temperature. As an alternative to an air source heat pump, a CO_2 loop for heat recovery could be utilized where CO_2 is constantly evaporated and condensed to respectively absorb and release a heat load. This heat load would come from a heat exchanging fluid used in a cooling process and released into a heat exchanging fluid used in a heating process.

Air Compressor Exhaust Ducting: The air compressors were also assessed as a potential source of heat recovery. Up to 90 percent of heat generated from air compressors can be reclaimed and used for other applications, such as space heating. In order to provide additional heating for JBS's loading zone during the winter, a ventilation system could tap directly into the air compressor's ventilation to provide heat. This would allow JBS to provide a more comfortable working zone while saving natural gas. This same proposition could be applied to the gas dryers. These dryers are connected to ductwork that delivers the excess heat outside of the plant. The exit of this ductwork is located on the rooftop above the main offices. This exit could be redirected to deliver heat to the main offices. In both areas, a damper should be installed to redirect any excess heat. Once approved by management, the implementation of this recommendation could be completed by a contractor who is already familiar with the air compressor area of the plant.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
DOUBLE PIPE HEAT EXCHANGER & UNIT HEATER	$13,900	3,650,000 gallons 32,352 kWh	RECOMMENDED
SHELL AND TUBE HEAT EXCHANGER	$23,590	3,500,000 gallons 141,556 kWh	RECOMMENDED
AIR SOURCE HEAT PUMP/ CO_2 HEAT RECOVERY	Further Analysis Needed	Further Analysis Needed	RECOMMENDED
AIR COMPRESSOR EXHAUST DUCTING	$21,195	51,322 therms	RECOMMENDED

JBS USA, LLC

AIDAN MCDERMOTT

SCHOOL: The University of Iowa

MAJOR: Mechanical Engineering

COMPANY PROFILE:

JBS USA is one of the world's largest food companies. The United States headquarters are in Greeley, Colorado. JBS USA produces more than 200 million servings of pork, beef, and poultry every year. JBS employs more than 260,000 people globally, with the Marshalltown, Iowa, plant employing approximately 2,500 people and processing 21,000 head of pork per day.

PROJECT BACKGROUND

The purpose of the intern project was to research and integrate methods and practices to reduce electrical usage at the Marshalltown plant. Working with staff and vendors, the intern applied best practices to ensure that mechanical aspects of the plant were running as efficiently as possible. Key areas of interest included some of the larger equipment, such as blowers and compressors, and electric motors for the conveyors. Recommendations were made that were cost-effective and easy to implement.

INCENTIVES TO CHANGE

Energy conservation is an important part of sustainability because of the role that greenhouse gases and emissions play in the production of electricity. In 2019, JBS USA committed to a net-zero carbon emission climate pledge by 2040, becoming the first company in its field to make such a commitment. As part of this, the Marshalltown plant set a goal to reduce electrical usage by 30 percent. These goals were motivated by the company's strong environmental values and commitment to a more environmentally friendly future.

RESULTS

Parking Lot Lights: The parking lot lights in the western parking lot were found to have a broken photo eye. This resulted in the lights being turned on all the time even though the lights were only necessary for a nine-hour period each day. A contractor was brought in to install a timer to control the external lighting and the recommendation to operate the lights only as needed has since been implemented.

Distribution Center Insulation Once product is packaged on the production floor, it is sent to the distribution center where it remains until it is shipped. Inside the distribution center, a system of fans and chillers are used to ensure that the building's interior stays below 32 degrees Fahrenheit to preserve the integrity of the product. Gaps were found throughout the building in some of the insulation, which resulted in the cooling system running more than necessary. The intern recommended repairing or replacing missing insulation throughout the plant.

Conveyor Belts: The Marshalltown plant uses hundreds of conveyors, both hydraulic and electric, for the rapid movement of products throughout the plant. The conveyors are left on all the time, because there are two production shifts that utilize the conveyors to carry product. A third sanitation shift runs the conveyors to ensure cleanliness. Turning off the electric conveyors during breaks, would reduce the amount of energy consumed by the conveyors. This project has been implemented.

Wastewater Air Conditioning: The wastewater building of the Marshalltown plant houses both the wastewater offices and the electrical room that houses the power source for the majority of the equipment in the wastewater building. During construction of the wastewater building, installation of the air conditioning units for the offices and the mechanical room were switched. This resulted in unexpected equipment failures due to overheating. It also meant that the

energy conservation system that was in place was not being utilized to its fullest potential. A contractor was brought in to switch the units back to their intended uses. This recommendation has been implemented.

ASP Blowers: In the Activated Sludge Processing (ASP) building, an aeration basin is utilized to reduce the levels of pollutants in the wastewater, which are formed from meat particulates that are sent down the drain. This generates high levels of sludge which requires pre-treatment, before being sent to an aeration basin. In the aeration basin, four blowers blow compressed air onto the sludge, where the oxygen helps to promote aerobic digestion to break down the sludge. Increasing the amount of polymer added to the water would reduce sludge levels and could allow one of the blowers to be turned off.

Dehair Steam Leaks: One of the largest steam users in the plant is the dehair area of the harvest floor. During an assessment of this process, numerous steam leaks were found, resulting in the overuse of steam. These leaks cause an increase in natural gas and water usage and also put a higher load on the system. The leak repairs were completed by an in-house maintenance team, resulting in a reduction of water and natural gas consumption.

Compressed Air and Steam Audit: Throughout the plant, piping systems that carry compressed air and steam have leaks that are causing the systems to work harder than necessary. Boiler and compressed air systems are both very energy intensive systems so any leaks cause the systems to be less efficient. It was recommended that a complete leak detection audit be conducted to identify and quantify all of the steam and compressed air leaks. It is recommended that a contractor be hired that could also repair the identified leaks to reduce natural gas, water, and energy usage by these systems.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
PARKING LOT LIGHTS	$2,800	35,000 kWh	IMPLEMENTED
DISTRIBUTION CENTER INSULATION	$93,750	1,171,700 kWh	RECOMMENDED
CONVEYOR BELTS	$5,485	68,550 kWh	RECOMMENDED
WASTEWATER AIR CONDITIONING	$15,500	18,670 kWh	IMPLEMENTED
ASP BLOWERS	$47,000	587,150 kWh	RECOMMENDED
DEHAIR STEAM LEAKS	$62,053	31,185 therms 3,127,921 gallons	IMPLEMENTED
COMPRESSED AIR AND STEAM AUDIT	Further Analysis Needed	Further Analysis Needed	IN PROGRESS

JASON CHRISTENSEN

SCHOOL: Iowa State University

MAJOR: Mechanical Engineering

NATIONAL CARWASH SOLUTIONS

GRIMES

COMPANY PROFILE:

National Carwash Solutions (NCS) is North America's leading carwash equipment, services and cleaning solutions provider in the vehicle care industry. Headquartered in Grimes, Iowa, with approximately 250 employees and more than 2,000 employees in the United States and Canada, NCS is committed to quality, service, and innovation. NCS is home to many world class brands, all providing unique assistance to the sale, service, and innovation of car wash technology. NCS believes that through spectacular performance and incomparable customer service, they can make a positive difference in the lives of their customers.

PROJECT BACKGROUND

National Carwash Solutions requested the service of a P2 intern to assess their compressed air system to improve energy efficiency and reduce annual electrical energy use. The intern was able to provide a baseline of the compressor's annual energy use as well as the monetary cost of operation. The intern then supplied recommendations to reduce these values with maintenance, repairs, compressor setting adjustments, and a preventative maintenance plan.

INCENTIVES TO CHANGE

Environmental sustainability is a priority at NCS, driving a new environmental, social, and governance (ESG) strategy to move the company toward its sustainability goals. With an emphasis on environmental strategies, NCS is seeking a template to create standardized ESG policies for its manufacturing plants. In addition to reducing energy use at the Grimes plant, this project could establish a platform for replication of improvements across all NCS facilities.

RESULTS

Decrease Compressor Pressure: The compressor that is in use at the facility runs between two pressure setpoints of 100 and 110 pounds per square inch (psi). Upon investigating the rated pressure ranges of the tools used in the facility connected to the compressed air system, it was concluded that the pressure range was too high and causing unnecessary strain on the compressor and tools as well as unnecessary energy use. The rated pressure ranges of these different tools vary but the maximum pressure was found to be 100 psi. Using the user interface screen on the compressor, maintenance staff can reduce the pressure range to 90-100 psi. This would ensure the compressor provides adequate pressure to the tools while using less energy. The pressure should be reduced by 1 psi per day so there is no noticeable drop in pressure during the adjustment period.

Repair Compressed Air Leaks: Using an ultrasonic leak detector, the intern conducted a survey of the facility's compressed air lines to locate and quantify leaks. Leaks in a compressed air system typically account for 20-25 percent of the energy use of the compressor, causing the compressor to work harder than necessary to maintain pressure in the plant. Leaks were commonly found in air tool quick connects as well as hose or pipe threading. However, some leaks are in components that are difficult to access by NCS maintenance staff such as the pipes that run along the ceiling. Outsourcing

the service to a contractor would ensure every leak in the system is repaired correctly. Repairing all of the leaks will result in energy savings, increased efficiency, and reduce the wear and tear on the compressor.

Variable Frequency Drive: At the time of the assessment of the compressed air system, it was found that the compressor was running at a load/unload setting, without utilizing its variable frequency drive (VFD) feature. The compressor would run at full power to pump air until the pressure reached an upper setpoint and then would remain idle until the pressure decreased down to a lower setpoint. A VFD setting is more efficient because it works to maintain a specific pressure by varying the power output to reflect the demand in the facility. Since the compressor used at NCS is outfitted with a VFD, a simple switch in the settings would enable it.

Compressed Air System Pipe Map: Over the years, NCS has expanded their facility as well as their compressed air system to provide new areas of manufacturing with compressed air. Compressed air lines run along the ceiling of the plant along with all other utility pipes. From the ground, all of these pipes look similar. The intern created a piping and instrumentation diagram that is overlaid on a map of the facility to help identify and locate the compressed air lines. This provides the staff with a reference tool to be used for any maintenance needs including future leak audits and system repairs.

Preventative Maintenance Plan: Preventative maintenance is important for keeping the compressed air system running efficiently. The intern suggested that NCS seek the service of a contractor to do full service maintenance on the compressor

once a year and that in-house periodic maintenance checks be conducted every few weeks to address problems that may arise. The plan also suggests the purchase of pipe labels and an ultrasonic leak detector to assist in conducting recurring leak audits every six months. This plan will help the company keep the compressor running at optimum efficiency, which will save energy and money.

Project Expansion: The groundwork started by the P2 intern at the Grimes facility provides a template to construct compressed air management plans at the other NCS facilities and see companywide savings. The estimated savings were calculated from preliminary data sent from the other five facilities in the NCS network. The intern presented replicable recommendations to each of the five production facilities to gather feedback and inform the other sites of potential cost and energy savings.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
DECREASE COMPRESSOR PRESSURE	$1,919	44,620 kWh	RECOMMENDED
REPAIR COMPRESSED AIR LEAKS	$1,965	59,029 kWh	RECOMMENDED
VARIABLE FREQUENCY DRIVE	$522	12,134 kWh	RECOMMENDED
COMPRESSED AIR SYSTEM PIPE MAP	$1,200 (One-Time)	-	IMPLEMENTED
PREVENTATIVE MAINTENANCE PLAN	$800 (One-Time) $1,579	- 35,417 kWh	IN PROGRESS
PROJECT EXPANSION*	$14,633	283,339 kWh	RECOMMENDED

**Forecasted savings based on scaled recommendations*

DALLEN HECKER

SCHOOL: Iowa State University

MAJOR: Chemical Engineering

TYSON FOODS INC. - HILLSHIRE BRANDS

STORM LAKE

COMPANY PROFILE:

Tyson Foods, Inc. - Hillshire Brands is one of the largest food companies in the world, specializing in protein production through meat processing and prepared foods. Tyson was founded in 1935 in Springdale, Arkansas by John W. Tyson. The company started out with a focus on raising chickens and grinding feed for farmers and since has grown to be a multinational company with operations located in 16 different countries, employing approximately 142,000 members. Tyson produces approximately 20 percent of the chicken, beef, and pork in the United States and is a leading protein producer for restaurants, schools, military bases, hospitals, care facilities, and all major distribution retail channels.

PROJECT BACKGROUND

The focus of the P2 intern project was to reduce solid waste generation through source reduction, improved recycling, and other landfill diversion efforts. Implementing strategies to reduce waste generation and reduce landfill disposal is important both economically and environmentally. At Tyson's turkey operation in Storm Lake, waste is generated throughout the plant and feed mill from production activities, packaging operations, and sanitation processes. The purpose of this project was to support the company to reach its goal of zero landfill status.

INCENTIVES TO CHANGE

Waste generation and landfill disposal is an ongoing concern worldwide as population grows and material consumption increases every year. Lowering the amount of waste both generated and landfilled is a first step in achieving environmental sustainability. Tyson is working towards building a sustainable and resilient food system that will be able to sustain the planet and feed future generations. To reach these goals, the company is working toward attaining zero landfill status by reducing solid waste generation and increasing landfill diversion.

RESULTS

Pallet Waste Collection: Pallets are used to transport material throughout the plant and are one of the primary waste streams generated at Tyson's Storm Lake turkey operations. Pallets that have broken down beyond the point of use are loaded onto a trailer and returned to the pallet vendor to be rebuilt. Even though most pallets are reused or recycled, this project identified sources of pallet waste that were not being recycled. One source of pallet waste was pallets that were not provided by the pallet vendor but arrived on site from shipments of inventory and other supplies. Another source of pallet waste was broken pallet boards and pieces that could not be transported by forklift. By developing new collection processes to transport these pallet waste streams to the vendor truck, an additional 26.1 tons of wood waste will be diverted from the landfill each year. These new collection processes have been implemented. Ongoing observations and education will continue to ensure long-term success.

Cardboard Recycling Program Enhancement: Tyson has a cardboard recycling program. Even so, some cardboard was consistently being placed in one of the plant's roll-off containers for waste. Through further investigation, it was

discovered that cardboard was being disposed by some plant personnel that were new and were not fully aware of the recycling process that had been established for their area. The intern provided education by meeting with department employees and creating signage to better direct employees to where the cardboard should be taken for recycling collection. This recommendation has been implemented and will continue with on-going monitoring and education.

Feed Waste Management: The feed mill generates quantities of organic feed waste that is collected in a trailer located outside the mill. Once the trailer is full, the waste is transported to the local landfill. A higher tipping rate is assessed by the landfill for their feed waste. Land application was investigated as a possible alternative to landfilling. To determine the feasibility of land applying this variable feed composition material, a lab analysis was conducted on a sample. Additional verification steps will be taken pending the results of this analysis. If the feed waste proves viable to land apply, 194 tons of waste could annually be diverted from the landfill.

Hand Dryer Installation: Paper towels are one of the primary waste streams generated by the plant. Sanitation is highly important in a food production environment. Employees must wash their hands anytime they enter and exit the production floor as well as numerous other times throughout their shifts. Because of this safety procedure, sizeable quantities of paper towel waste are generated. As an alternative to paper towels, the intern identified a hand dryer that is certified for use in food production environments. These hand dryers could be installed in all wash stations throughout the plant, as well as in all non-production areas, to effectively eliminate paper towel use. The intern recommended that a pilot program be implemented by installing dryers in a few strategic locations. After evaluating the durability and effectiveness of the dryers, an informed decision regarding full scale implementation could be made. The proposal is awaiting corporate-level approval.

Expanded Recycling Program: The current recycling program at Tyson captures cardboard, paper, and plastic barrels. Beyond this, other regularly generated waste streams were identified to potentially expand the recycling program. The intern investigated vendors that have the capability of recycling plastic liners, poly super sacks, and Kraft paper ingredient sacks. A plan for capturing these materials has been presented to management for approval.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
PALLET WASTE COLLECTION	$5,348	26.1 tons of wood	IMPLEMENTED
CARDBOARD RECYCLING PROGRAM ENHANCEMENT	$1,562	6.7 tons of cardboard	IN PROGRESS
FEED WASTE MANAGEMENT	-	194 tons of feed	RECOMMENDED
HAND DRYER INSTALLATION	$67,759	13.36 tons of paper towels	RECOMMENDED
EXPANDED RECYCLING PROGRAM	-	67.5 tons of mixed recyclables	RECOMMENDED

LUIS HERNANDEZ

SCHOOL: Iowa State University

MAJOR: Mechanical Engineering

YOKOHAMA TWS

CHARLES CITY

COMPANY PROFILE:

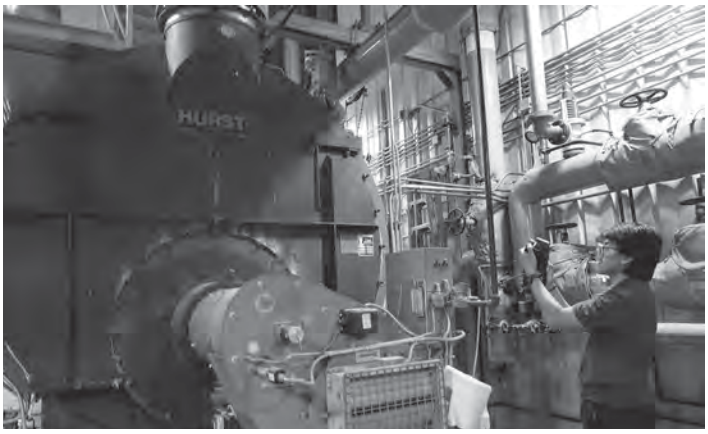
Yokohama is a tire and wheel company based in Tokyo, Japan. Previously operating as Trelleborg Wheel Systems, the Charles City, Iowa, plant was recently acquired to produce tractor tires, manufacturing around 8,500 tons of tires per year. Now operating as Yokohama TWS, the plant is a leading global supplier of tires and complete wheels for agricultural and forestry machines, materials handling, construction vehicles, motorcycles and other speciality segments. Yokohama TWS, a partner of leading original equipment manufacturers, offers highly specialized solutions to create added value for its customers. The plant operates 24 hours a day, 6 days a week, and employs 150 team members.

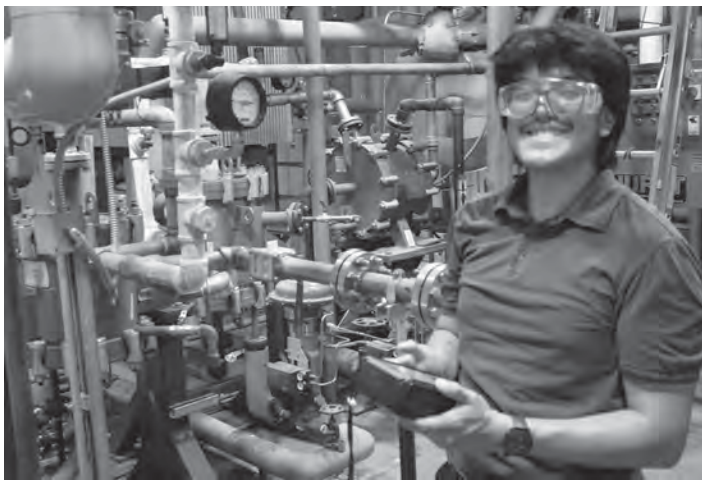
PROJECT BACKGROUND

Steam is the primary resource used in the curing process of tires and Yokohama relies on boilers running constantly to produce that steam. Seeking to improve the operating efficiency of the boiler and steam system, the company joined with the Iowa Pollution Prevention Intern Program to complete an assessment of the boiler and steam system and establish a baseline to better understand costs and improvement opportunities. The intern was then tasked with researching and recommending improvements that could lead to reductions in utility use and associated costs.

INCENTIVES TO CHANGE

Yokohama TWS is committed to continuous improvement of environmental stewardship at every level of the production process. The Charles City plant is ISO 14001 certified and continually strives to use resources more efficiently and improve the impacts of the operation on the environment and on human health. Improving the efficiency of the operating systems at the plant will assist Yokohama TWS to reduce environmental emissions while maximizing profits. Optimizing the boiler and steam system will provide savings of natural gas, water, and pre-treatment chemicals, and could reduce emissions.





RESULTS

Optimize Boiler Efficiency: Currently, the building heat is provided by five direct-fire natural gas furnaces. A 500-horsepower boiler is used to produce steam for use in the curing process for the tires and runs continuously at a relatively low load. Boilers operate more efficiently at a higher load so using steam to help heat the building would increase operating efficiency. A recommendation was made to purchase steam coils, steam traps, pipes, and valves to deliver steam to the furnaces that provide heat for the plant during the winter. The steam coils would be installed inside the current furnaces where steam would enter the coils and liquid condensate would leave. The latent heat of the water would be extracted and sent to the prep and curing departments. Yokohama will need to follow up with the vendors to supply the steam coils and any additional piping needed.

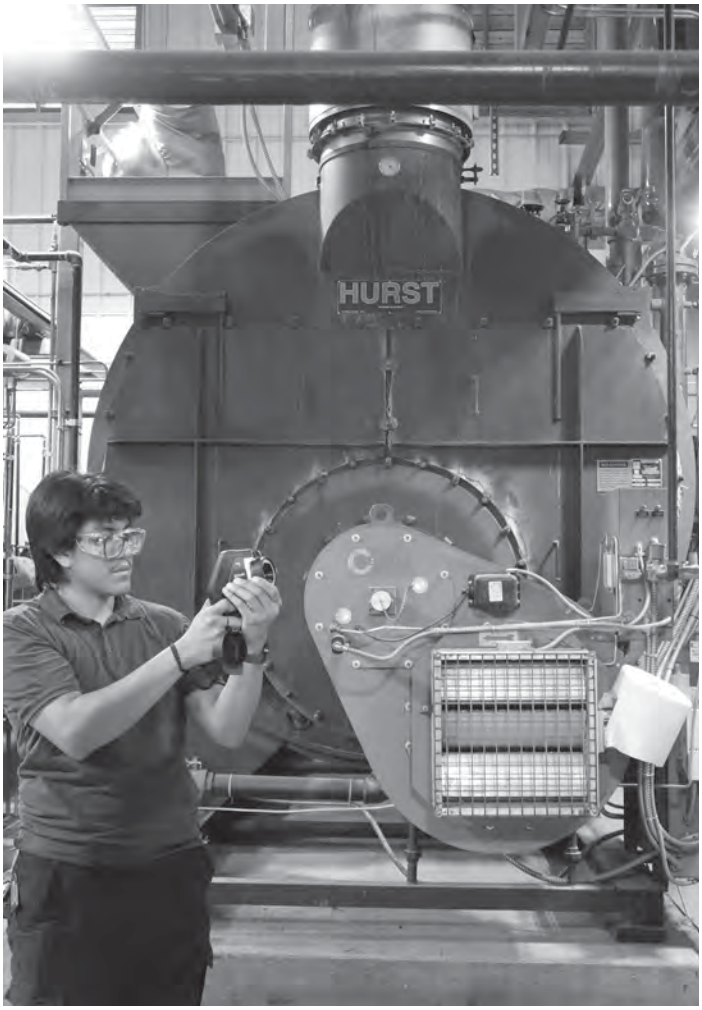
Install Boiler Natural Gas Meter: The boiler is a large energy user in the plant. Natural gas is currently only metered coming into the building without being narrowed down to specific systems. Submetering can help the boiler operators monitor natural gas usage and identify process trends and variances with real time data. Research shows that increased awareness

with submetering can reduce energy consumption by 3 to 5 percent. Submetering the boiler and other large energy users is recommended. The intern researched natural gas meters and identified a viable in-line option. Installation could be completed by the in-house maintenance team during a plant shutdown.

Re-route Boiler Blowdown: Blowdown steam and water from the boiler are cooled and then directed to the drain. Reusing this hot water is very attractive because it is the same temperature as steam (210°C). Using this blowdown as feedwater is not feasible because it would need to be thoroughly cleaned and chemically treated before it re-entered the boiler. Instead, the blowdown steam and water could be sent to the flash tank where the heat would be distributed to the heat exchangers that preheat the boiler feedwater, thus increasing the efficiency of the boiler.

Replace Spiral Heat Exchanger: A spiral heat exchanger preheats feedwater for the boiler. This heat exchanger is designed for a more complex process that is not applicable to the tire making process. A plate and frame heat exchanger has a simpler design that could increase heat transfer efficiency by 20 percent. Thus, a recommendation was made to replace the spiral heat exchanger with a plate-and-frame heat exchanger to increase efficiency and reduce associated costs. Yokohama will need to contact a vendor to purchase the new heat exchanger. Installation of the new heat exchanger could be done by the in-house maintenance team.

Insulate Cold Domestic Water Pipe: The incoming cold-water pipe for domestic water is located on the mezzanine inside the boiler room where the water regularly reaches temperatures exceeding 100°F. Because the cold-water pipe is not insulated, the high temperature of the boiler room causes the pipe to sweat and condensate, potentially causing damage to underlying equipment. Maintaining this pipe at the coldest temperature would optimize the heat transfer rate. Installing insulation around the 22 feet of pipe would help maintain the colder temperature and reduce condensate before it is fed into the first heat exchanger. The insulation could be installed by an in-house maintenance team.



ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
OPTIMIZE BOILER LOAD	$9,577	24,067 therms	RECOMMENDED
INSTALL BOILER NATURAL GAS METER	$6,900	17,337 therms	RECOMMENDED
RE-ROUTE BOILER BLOWDOWN	$3,560	4,496 therms	RECOMMENDED
REPLACE SPIRAL HEAT EXCHANGER	$2,300	5,780 therms	RECOMMENDED
INSULATE COLD DOMESTIC WATER PIPE	$906	2,276 therms	RECOMMENDED

2023 PROJECT INDEX

POLLUTION PREVENTION INTERN PROGRAM

CHEMICAL REDUCTION/REPLACEMENT

- Cambrex Charles City
- CJ Bio America

COMPRESSED AIR

- Dee Zee, Inc.
- National Carwash Solutions

ENERGY REDUCTION

- Ajinomoto Health & Nutrition North America, Inc.
- Burke Marketing Corporation - Hormel Foods
- Cambrex Charles City
- Dee Zee, Inc.
- JBS Swift Pork
- JBS USA, LLC
- National Carwash Solutions
- Yokohama TWS

HEAT RECOVERY

- JBS Swift Pork
- Yokohama TWS

PROCESS IMPROVEMENT

- Ajinomoto Health & Nutrition North America, Inc.
- Anderson Erickson Dairy - Shrink Reduction
- Anderson Erickson Dairy - Washout
- CJ Bio America
- Dee Zee, Inc.
- JBS Swift Pork
- JBS USA, LLC
- Tyson Foods, Inc. - Hillshire Brands
- Yokohama TWS

SOLID WASTE MANAGEMENT

- Tyson Foods, Inc. - Hillshire Brands

WASTEWATER

- Burke Marketing Corporation - Hormel Foods

WATER USE REDUCTION

- Ajinomoto Health & Nutrition North America, Inc.
- Anderson Erickson Dairy - Washout
- Burke Marketing Corporation - Hormel Foods
- Cambrex Charles City
- JBS Swift Pork
- JBS USA, LLC

pollution prevention services