WORKING TOGETHER TO ACHIEVE ECONOMIC AND ENVIRONMENTAL RESULTS

POLLUTION PREVENTION SERVICES

2024 INTERN PROGRAM CASE SUMMARIES

pollution prevention services

www.iowap2services.com

CASE SUMMARIES WRITTEN BY
2023 and 2024 P2 Interns

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DIRECTOR'S NOTE

At the Department, we're about improving the quality of life in Iowa and ensuring a legacy for future generations. The DNR's Pollution Prevention (P2) Intern Program assists Iowa companies in using their resources more efficiently, whether conserving water through reuse or reduction, conserving energy, reducing or eliminating the use of hazardous materials, and reducing solid waste. In most instances, these projects provide ongoing environmental improvement. These projects not only help the environment but also enhance recreational opportunities.

Iowa companies can receive technical assistance through the P2 Program. The P2 Intern Program matches participating host companies with upper-level engineering students who assess their operations and processes. These interns bring their technical and analytical skills to compile data, research solutions, quantify impacts, and make recommendations for environmental improvements in a final report on their focused project.

Since 2001, the P2 Intern Program has joined forces with Iowa businesses and organizations to conserve and protect our natural resources, making life better for everyone in Iowa. Participating companies have reported more than 120.2 million in savings after implementing their interns' recommendations. These achievements are shown in the charts below.

I commend the participating companies, the top-level interns, and the P2 Services team for their dedication to improving the quality of the outdoor environment and life in Iowa.

- Kayla Lyon
Director, Iowa Department of Natural Resources

TOTAL IMPLEMENTED SAVINGS 2001–2024

POLLUTION/WASTE REDUCTION & COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	6,299,362,105	gallons	$19,997,438
SPECIAL WASTE	76,208	tons	$2,211,083
SOLID WASTE	208,133	tons	$17,760,331
HAZARDOUS WASTE	10,426	tons	$18,914,434
MERCURY ABATED	42,817	grams	
ENERGY	516,066,024 4,314,872 25,535,384	kWh *MMBtu therms	$29,712,125 – $17,076,473
OTHER			$14,600,762
			TOTAL: $120,272,646

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

2001–2024 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
0.202	2.490	0.724	0.282	3.101	3.878	2.372

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
985.784	530.51	75.908	8.211	1599.145

2024 EXECUTIVE SUMMARY

The Department of Natural Resources (DNR) collaborated with ten upper-level engineering students through the 2024 Pollution Prevention (P2) Intern program to help companies achieve their environmental goals. This initiative fosters a unique partnership among academia, business, and government, generating significant economic and environmental benefits. The interns worked closely with P2 advisors to address key areas such as water and energy reductions, resource recovery, hazardous waste usage and reduction, and process efficiency. Opportunities for more than $3.4 million in annual savings were identified. Of these projects estimated to save $982,401 annually have been implemented or are in progress.

In 2023 and 2024, the program included extensive 28-week projects at Ajinomoto Health & Nutrition North America, Inc., focusing on process improvements for energy and water efficiency. These extended internships allowed for comprehensive research and system evaluation under various conditions, resulting in deeper insights and more impactful recommendations. The extended timeframe enables interns to thoroughly assess the effects of process changes and make necessary adjustments.

The P2 Intern program is an extension of DNR's non-regulatory Pollution Prevention Services, which provides confidential, technical assistance to Iowa businesses. This initiative not only delivers innovative solutions and fresh perspectives from the interns but also offers them valuable real-world experience. The successful outcomes from the 2024 projects demonstrate the effectiveness of collaborative efforts between companies, students, and the DNR in achieving meaningful environmental improvements.

2024 ENVIRONMENTAL SAVINGS

ACTUAL POLLUTION/WASTE REDUCTION AND COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	37,740,188	gallons	$753,964
SOLID WASTE	2,292.49	tons	$127,280
HAZARDOUS WASTE	0	tons	$0
ENERGY	44,220 107,620 1,074,694	kWh *MMBtu therms	$5,039 – $96,118
			TOTAL: $982,401

**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 16, 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 2024 PROJECTS THROUGH AUGUST

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
0.202	2.490	0.724	0.282	3.101	2.372	3.878

GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
985.784	530.510	75.908	8.211	1599.145

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 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 examples of how quickly savings can add up when prioritizing stewardship of resources.

YOUR COMPANY IS ELIGIBLE TO WORK WITH POLLUTION PREVENTION SERVICES IF:

1) You are a business, industry, institution (e.g. hospital, educational campuses), or governmental agency with 100 or more employees.

2) You employ fewer than 100 people, but meet at least one of the following criteria:

- **Toxic Release Inventory (TRI) reporter**
- **Resource Conservation and Recovery Act (RCRA) Large-Quantity Generator of hazardous waste**
- **Large Utility User (greater than $1 million in energy and water usage and waste disposal annually).**

POLLUTION PREVENTION: COMPANY PROJECT REQUESTS

FOR COMPANIES WISHING TO MAKE A PROJECT REQUEST

Pollution Prevention Services is currently accepting requests for 2025 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 6, 2024, to be considered for a 2025 intern placement.

Project requests will be reviewed upon receipt and companies 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 2025.

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

COMPANY TESTIMONIALS

"Kemin is committed to sustainability, and the P2 program helps accelerate our journey to unlocking more energy efficient manufacturing practices. The program also gives an intern real world work experience, preparing the next generation of environmental stewards."

–JENNIFER DUCRAY
NORTH AMERICA SUSTAINABILITY MANAGER
KEMIN INDUSTRIES

"Our company has utilized this P2 program for the past two summers. We feel that this is an excellent resource to help accelerate our continuous improvement projects and improve our sustainability efforts. We look forward to participating again in the future."

–SCOTT GROH
DIRECTOR OF PLANT OPERATIONS
ANDERSON ERICKSON DAIRY

"This program is a great opportunity to work with up-and-coming engineers that help our company with our sustainability goals as well as giving them real world experiences."

–DAVE SAMPLE
ASSOCIATE SER MANAGER
AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.

IS A P2 INTERNSHIP THE RIGHT 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.

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 2025.

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 19th 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.

"The pollution prevention project benefitted both the intern and our company. Our intern was self-motivated and interested in learning about our facility, identifying our baseline costs for producing process water and highlighting potential savings in water treatment chemical usage. We encourage participation in this program and see it as a mechanism to mentor future industry professionals."

–NEIL STOCKFLETH
ENVIRONMENTAL SUPERINTENDENT
CF INDUSTRIES PORT NEAL COMPLEX

2024 POLLUTION PREVENTION INTERNS

JONATHAN CHAN:

"Interns with this program get tremendous professional experience with real-world engineering, communication, problem-solving and critical thinking skills. You get the opportunity to learn not just how to tackle an engineering project but how to build relationships with other professionals in order to achieve your goal."

AMAN CHAUDHARY:

"My P2 internship allowed me to acquire real-life experiences in P2 and embrace P2 practices in a professional engineering work environment. Interns get to learn more about environmental problems and be a part of projects that create a benefit not just for their host company but also for society and the world."

ANNA CHRISTOPHERSON:

"This P2 internship provided true hands-on experience in a factory environment, and I completed my project knowing I had made a real and meaningful impact on my host company."

AUSTIN JONES:

"The application of coursework in a professional context like this is extremely rewarding and allows for a newfound confidence in your abilities. I got to provide my company with a way to impact their environmental footprint that they might not have thought possible before."

CASIE MEYER:

"I got to see how concepts I learned in school are used in the real world and will be able to apply everything I learned in my P2 internship to my future education and career. My professional confidence also increased dramatically – I felt so much more confident in my engineering knowledge, problem-solving skills, and communication skills."

ASH RAMESH:

"This internship was a great introduction into the world of being a true engineer. I've grown tremendously and would encourage other students to pursue this opportunity. It was a fantastic experience!"

ANANYA SIVASHANKER:

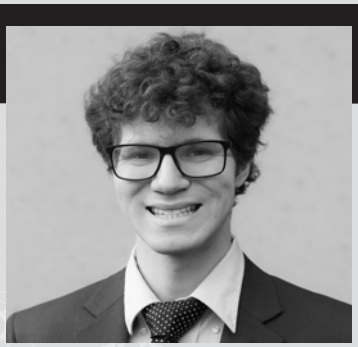
"I've definitely gained confidence in my ability as an engineer. I got to learn how to properly listen to the needs of a company and develop meaningful solutions."

BRAM SUEPPEL:

"My P2 internship was a great experience. With the amount of creative freedom given, you get to see a major impact from your project at the company, which is unlike most other internships where you might just be collecting data and performing experiments."

AVERY VEST:

"The P2 program was incredibly beneficial to both my personal and professional career. I gained hands-on experience at an extremely large process engineering facility and was able to connect with some of the leading professionals in the field."



JASON MELNICK
SCHOOL: Iowa State University
MAJOR: Mechanical Engineering

AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.

EDDYVILLE

2023 28-WEEK CO-OP PROJECT

COMPANY PROFILE:

Ajinomoto Health & Nutrition North America, Inc. (Ajinomoto), founded in 1909, is a Japanese-based food and amino acid producer with more than 34,000 employees worldwide and annual sales exceeding ten billion dollars. Dedicated to its mission to improve the health of humankind, Ajinomoto produces high quality products to resolve food and health issues globally. Ajinomoto is the world's largest producer of monosodium glutamate (MSG), a flavor enhancer that is naturally present in many foods. The location in Eddyville, Iowa, focuses on the production of MSG as well as amino acids for farm animal consumption, including lysine, threonine, and tryptophan.

PROJECT BACKGROUND

The focus of this project was to improve data collection on Ajinomoto's emission points and utilities. The intern was tasked with creating a program to organize and analyze information from emission point control equipment and with establishing a baseline for electrical and water usage. The intern analyzed this data to develop recommendations to reduce electrical and water usage and to reduce emissions of particulate matter.

INCENTIVES TO CHANGE

With a mission to improve global wellness, 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 places a large emphasis on environmental initiatives and has pledged to reduce its companywide environmental impact 50 percent by 2030.

RESULTS

Emission Point Monitoring and Maintenance Plan
After compiling a large amount of data, the intern created a tool that collects and organizes data electronically from the emission point control equipment and analyzes the data for issues and abnormalities. This information can then be used to quickly detect and locate the source of an issue. This data collection and analysis tool has been implemented and is currently being used by the environmental team. Emission point control parameters, such as pressure drop and flow rate, occasionally fall outside of optimal range, which can cause an increase in particulate matter emissions. A Preventative Main-

tenance Plan was recommended to reduce the occurrence of these events and prolong the lifespan of the equipment. At the end of the internship, the preventative maintenance plan was being reviewed for approval and implementation.

Cold Lime Water Softening

Ajinomoto has two options for water, onsite wells or sourcing it from a third party. The hard well water has a high concentration of total dissolved solids, leading to a buildup of scale within systems where it is used, such as the cooling towers and chillers. Scale buildup has reduced heat transfer efficiency, requiring these systems to use additional electricity. To decrease scale build up, treated water has been sourced from a third party.

A cold lime water softening system could provide a viable on-site water source for the cooling towers at the plant. Softening lowers the amount of total dissolved solids, and in turn, reduces scale buildup in the equipment and systems. Using well water to reduce scaling improves both the flow and efficiency of the heat transfer, reducing maintenance of the operations and costs associated with water usage. Using water with a lower amount of total dissolved solids allows the cooling towers to cycle water more times, leading to less overall water usage. This recommendation provides a financially and environmentally responsible method to achieve water independence. Additional research is needed to further explore the operational impacts of integrating cold lime softening at the plant.

Air Compressor Efficiency Optimization

An air compressor's efficiency increases the closer it operates to its maximum capacity. For this reason, it is more efficient to run fewer compressors close to maximum capacity rather than many air compressors at a lower rate. Currently, Ajinomoto runs more air compressors than necessary to meet the facility's demand for compressed air. Creating a new program on the programmable logic controller that controls the compressed air system will allow for more efficient operation by running fewer compressors, significantly reducing the energy usage of the compressed air system.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
EMISSION POINT MONITORING	$30,000 (ONE-TIME)	–	IMPLEMENTED (Monitoring)
MAINTENANCE PLAN	–	1.29 tons PM	RECOMMENDED
COLD LIME WATER SOFTENING	$984,054	130,705,600 gallons 6,997,171 kWh	FURTHER RESEARCH NEEDED
AIR COMPRESSOR EFFICIENCY OPTIMIZATION	$372,524	5,138,266 kWh	RECOMMENDED

SHANE KELSEY

SCHOOL: Iowa State University
MAJOR: Chemical Engineering

AJINOMOTO HEALTH & NUTRITION NORTH AMERICA, INC.

EDDYVILLE

2024 28-WEEK CO-OP PROJECT

COMPANY PROFILE:

Ajinomoto Health & Nutrition North America, Inc. (Ajinomoto), founded in 1909, is a Japanese-based food and amino acid producer with more than 34,000 employees worldwide and annual sales exceeding ten billion dollars. Dedicated to its mission to improve the health of humankind, Ajinomoto produces high quality products to resolve food and health issues globally. Ajinomoto is the world's largest producer of monosodium glutamate (MSG), a flavor enhancer that is naturally present in many foods. The location in Eddyville, Iowa, focuses on the production of MSG as well as amino acids for farm animal consumption, including lysine, threonine, and tryptophan.

PROJECT BACKGROUND

The objective of the 28-week co-op is to analyze the water chiller system at the Heartland plant and find points of inefficiency, research potential solutions and recommend further action. The intern focused on the buildup of scale within the chillers that is caused by the hard water that is used in the system. The first half of the project has been spent establishing a baseline while the second half will be used for researching solutions along with creating an action plan for the aforementioned solutions.

INCENTIVES TO CHANGE

As a company, Ajinomoto has been committed to sustainability and the reduction of greenhouse gasses. Ajinomoto has the goal of reducing their environmental impact 50 percent by 2030 and increase the life expectancy of one billion people. From an environmental perspective, this project aims to substantially reduce the water usage by the cooling towers, which will decrease the stress placed on the deep wells and the Des Moines River that Ajinomoto draws from. This would also result in a decrease in electric costs, as the chillers would be using less power and running more efficiently. Along with both of these benefits, the amount of water lost in the system should be reduced.

PROJECTS

The issues that Ajinomoto is facing regarding the efficiency of the chillers and the amount of water being used by cooling towers can be explained by one source. That source is the amount of minerals in the water, commonly referred to the hardness of the water. The intern, in collaboration with the senior engineer and sustainability engineer, has determined that the water needs to have the minerals removed in order for the project to have quantifiable results. This is due to the water hardness being determined to have a substantial effect on both the efficiency of the chillers and the amount of water used by the cooling towers. This process is known as softening the water. This conclusion has narrowed the potential recommendations down to two possible solutions.

Cold Lime Softening

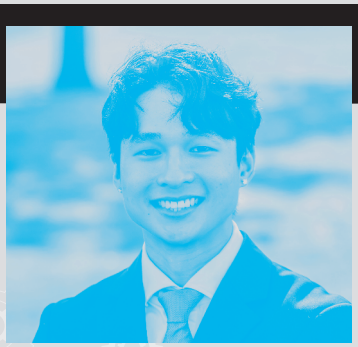
A cold lime softening (CLS) system is the first and most effective way to remove the hardness from the water. A CLS system uses lime crystals to react with the ions in the water, namely calcium and magnesium, turning them into solids that form a sludge that sinks to the bottom of the machine before being removed and disposed of. This system has many benefits such as being scalable, meaning it can be added onto in the future. Along with this, the amount of times water can be cycled through the cooling towers before needing to be discharged would be almost double thus significantly decreasing the amount of water that is needed to be pumped into the cooling towers as make up water. The CLS system also could produce enough clean soft water to provide for the entire Ajinomoto plant, thus eliminating the need for outside sources of soft water currently being used and have been a source of cost in the past.

Reverse Osmosis Refurbishment/Expansion

Another option to clean the water is to increase the Reverse Osmosis (RO) skid water usage which is currently being underclocked in terms of filtering capacity. This water is cleaner than the CLS water and has a lower initial cost, however, the space is more limited and there is a theoretical limit to how much water can be produced from the RO skids. The skids use RO to pull out the ions and other debris to be disposed of. This system has many of the same benefits as the CLS system such as reducing or eliminating dependency on outside sources of water and reduced make-up water needs. This can be accomplished by doing one or both of the following, refurbishing older RO skids and running them at normal rates instead of underclocking them or installing new skids next to the current ones. Both options may be implemented over time, however, the one with the shortest timeline would be refurbishing older models and adjusting the amount of flow that goes through the skids.

Next Steps

For the remainder of the 28 weeks, the intern will continue to collect relevant data and refine the baseline model. Following this, the intern will calculate the theoretical environmental and economic benefits of each option previously mentioned. This will be accompanied by communicating with vendors about obtaining quotes for the different projects and eventually choosing which appears to be the best and formally recommending that to Ajinomoto. After a recommendation has been made, the intern will spend the remainder of the co-op term finalizing documentation and preparing the project to start after the end of the internship or further modeling so future projects can be easily assessed on feasibility.



JONATHAN CHAN
SCHOOL: Iowa State University
MAJOR: Mechanical Engineering & Concurrent MBA

ANDERSON ERICKSON DAIRY - SHRINK REDUCTION

COMPANY PROFILE:

Anderson Erickson (AE) Dairy, headquartered in Des Moines, Iowa, is the state's largest independently owned dairy company and has been providing premium dairy products since 1930. Known for its commitment to quality and freshness, AE Dairy sources its milk locally from Iowa farms, ensuring the highest standards for its products. Operating 24/7 with approximately 450 employees, AE Dairy produces a variety of milk products, sour creams, yogurts, ice cream mixes, cottage cheeses, and various seasonal products like eggnog, orange juice, and lemonade.

PROJECT BACKGROUND

AE Dairy receives an average of 870,000 pounds of milk daily, which is then processed, packaged, and stored in a cooler before delivery to customers. The difference between the raw milk received and the finished milk product stored in the cooler is tracked as milk loss, and referred to as 'shrink'. AE Dairy partnered with a 2024 P2 intern to evaluate and identify sources of shrink throughout the production process, and develop effective solutions to reduce product loss.

INCENTIVES TO CHANGE

AE Dairy is dedicated to reducing milk loss in its production process. By minimizing waste, the company not only demonstrates their commitment to sustainability and environmental responsibility, but also improves their overall operational efficiency. Through the implementation of advanced technologies and continuous process improvements, AE Dairy aims to maximize every drop of milk for production, reducing costs and fostering a more sustainable dairy industry. This proactive approach benefits the company's financial performance and aligns with its mission to provide top-quality dairy products while minimizing its environmental impact.

RESULTS

Air Blow System on VAT Line & PT8 to PT9 Line
Between each product run on these two production lines, remaining milk product must be emptied from the lines. Currently this process is accomplished by using water to flush the milk out, which results in product loss. If an air blow system was used instead, residual milk product in the lines could be pushed using compressed air instead of water. This would allow for the milk to be pushed back to the supply tanks and effectively recovered, reducing waste and improving operational efficiency. The air blow system is compatible with the facility's Clean-In-Place (CIP) procedures, which will minimize maintenance requirements. To ensure proper functioning, new Standard Operating Procedures (SOPs) for filter replacement and regular system inspections have been established. The air blow systems for these lines have been successfully implemented and are currently in use.

Air Blow System on Mix Proof Cluster
Between each production changeover, remaining milk product must be emptied from the lines and the filler machines. Operators perform a "canning off" process, where large stainless-steel milk cans are used to manually capture and recover milk discharged through the manifold valves. The process is labor-intensive and time consuming. Air blows could instead be installed on the mix proof cluster, with a sophisticated valve arrangement that would keep individual milk product lines segregated. The product remaining in the lines can be blown directly into the filler bowls, thus eliminating the need for canning off. To implement, SOPs and employee training will be needed to establish the new process.

SOP for Return to Cooler (RTC)
When excess product is brought back to the cooler warehouse

by delivery drivers it must be returned into cooler inventory (referred to as Return to Cooler, or RTC inventory). Processing returned products requires considerable time and labor for sorting and restocking, and if it doesn't happen right away it can lead to lost product and incorrect inventories. To improve this system, the development of an SOP will improve the handling and timely processing of RTC inventory. The SOP will improve inventory accuracy by adhering to first-in-first-out practices, which will reduce lost product and enhance operational efficiency. The new SOP process is currently under review by plant management.

Loss Log on End of Shift Cooler Report
A baseline assessment completed by the P2 intern generated detailed metrics of product loss from the facility's cooler. However, there is no additional data currently collected on an ongoing basis to track details of product spills and losses from the cooler. Adding a Loss Log section to the End of Shift (EOS) report would allow employees to collect and track detailed metrics on product loss occurring during each production shift. An EOS is generated at the end of each shift to communicate information about that shift to management and to the next shift of employees, and loss log data included as part of this report will enable detailed tracking and reporting of incidents, identify root causes of shrinkage, and improve overall efficiency. This recommendation has been successfully implemented, and management review of future data will identify trends and guide future improvements.

Cooler Bays Preventative Maintenance
Finished products in the cooler are stored in bays and are transported back and forth through a system involving conveyers, rollers, pallets, and a braking system. As mechanical failures occur – faulty brakes, loose rollers, etc. – they can cause product

spills, and maintenance staff may not always be aware of the issues. Implementation of a preventative maintenance program with regular maintenance inspections and repairs will ensure timely identification and resolution of equipment issues, and reduce product loss and down time.

Updated Procedures for Unloading Raw Material Tanks
AE Dairy uses three different types of sugar in its production process. Each type is delivered by tanker trucks and pumped into the corresponding product tanks. If one of these raw materials was inadvertently pumped into the wrong tank it would generate a significant amount of wasted raw material in addition to significant production downtime. Implementing a double verification system that would involve at least two plant representatives would eliminate the potential risk. The proposed multi-step process would incorporate cross-referencing the Bill of Lading, visual product inspections, and multiple employee signoffs. The updated process SOP has been submitted to management for review.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
AIR BLOW SYSTEM ON VAT LINE & PT8 TO PT9 LINE	$116,592	489,267 lbs. Milk	IMPLEMENTED
AIR BLOW SYSTEM ON MIX PROOF CLUSTER	$46,654	196,023 lbs. Milk	RECOMMENDED
SOP FOR RETURN TO COOLER	$5,344	21,934 lbs. Milk	IN PROGRESS
LOSS LOG ON EOS COOLER REPORT	$5,344	21,934 lbs. Milk	IMPLEMENTED
COOLER BAYS PREVENTATIVE MAINTENANCE	$16,033	65,803 lbs. Milk	RECOMMENDED
UPDATED PROCEDURES FOR UNLOADING RAW MATERIAL TANKS	$25,000	10,000 gallons Raw Materials	RECOMMENDED

ANDERSON ERICKSON DAIRY - WATER

COMPANY PROFILE:

Anderson Erickson (AE) Dairy is a distinctly Iowan dairy company. Founded in Des Moines, Iowa, in the year 1930, the corporation's headquarters currently retains over 400 employees. AE Dairy produces a variety of high-quality dairy products, including milks, yogurts, juices, sour creams, and other seasonal items. Their products are almost exclusively distributed within Iowa in an effort to reduce fuel emissions, and the company partners with MidAmerican's Renewable Advantage Program to strive for carbon neutrality. For the past two years, AE Dairy has requested the help of the DNR's Pollution Prevention services for both water usage and shrink reduction.

ANNA CHRISTOPHERSON
SCHOOL: The University of Iowa
MAJOR: Mechanical Engineering

PROJECT BACKGROUND

Throughout the summer, the intern aimed to reduce the environmental impact of AE Dairy's water usage while lowering costs. Based on collected baseline data, approximately 70 percent of AE Dairy's water costs come from sanitation processes. Tank cleanings are the largest users, consuming 45 percent of water used at the plant. To combat this, the intern tested the use of a turbidity sensor on a Clean-In-Place (CIP) skid and rotary spray heads in place of the tanks' stationary spray balls. The intern also discovered savings opportunities at the plant's rinse stations, which clean containers of product spillage from the filling process.

INCENTIVES TO CHANGE

Anderson Erickson Dairy upholds a reputation as an Iowa-local dairy company with a close connection to farmers and the land. Their motto, "ridiculously high standards," refers to the high quality of milk used in every one of their dairy products. In addition to their product standards, the company strives to be responsible stewards of the environment. AE Dairy is in the pursuit of 100 percent renewable energy and aims to transition to fully sustainable packaging. The company's next steps towards sustainability include the reduction of their water usage at the source while reducing costs in the process.

RESULTS

Product Rinse Modifications

Products packaged in bottles and cartons are transported on conveyors and pass beneath product rinses to remove any milk residue from the containers. There are numerous rinse stations throughout production and each presented opportunity to reduce excess water usage. Rinses are not all set up the same way, so recommendations were dependent on the current mechanics of each station. For many, reduced flow rates from the nozzles were found to still achieve the same level of clean while using less water. Positioning of the nozzles were also adjusted to maximize rinse effectiveness. Implementation of a sensor to shut off water flow during pauses in production would eliminate needless water usage. In combination, individualized updates to each station will save water and electricity, and improve operational efficiency. Work orders for each station upgrade have been submitted and are awaiting completion.

CIP Turbidity Sensors

The CIP system at AE Dairy consists of four timed stages. First, fresh water is flushed through the system to remove any remaining product (a "pre-rinse"). Then a wash solution is recirculated through the system to kill bacteria and remove protein buildups. Fresh water is then flushed through the system and lastly a sanitizing solution is used. Because the length of the rinse stages are timed rather than based on reaching a fully clean state, excess water is frequently used.

Turbidity sensors measure the quantity of suspended particles within a fluid, and could improve the water efficiency of the pre-rinse stage by automatically ending the pre-rinse when all remaining milk product is removed from the rinse stream. However, many variables exist that could impact their effectiveness, including the type of product being rinsed. Extensive testing was conducted on the effectiveness of turbidity sensors across all eight of the facility's CIP skids (which hold and administer the various chemicals necessary throughout the process). Based on this testing, installation of turbidity sensors is recommended on seven of the eight CIP skids. Installation is underway, with one skid completed and implementation instructions in place for the remaining six skids.

Rotary Spray Heads

AE Dairy has 75 tanks throughout its plant. When these tanks get emptied of a product or chemical, a CIP process occurs to prepare it for refilling. During this process, water and cleaning chemicals are sprayed throughout the tank using metal balls with many small holes, called spray balls. AE's current spray balls are stationary, spraying straight streams of water towards the walls of the tank, and the parts of the tank that do not receive direct water contact are cleaned by the falling water. The stationary spray balls are also prone to clogging from more viscous products. Last year's P2 intern recommended replacing these spray balls with mobile rotary spray heads, which provide a much greater water impact on all sides of the tank and reduce the volume of water needed for cleaning.

Extensive individualized testing was needed to evaluate the effectiveness of this change within the many different tank and product environments. The testing data collected on small- and medium-sized tanks indicated an average water usage reduction of 23 percent per tank and significantly higher levels of cleaning reliability. Implementation will include the purchase and installation of additional spray balls for designated tanks

along with all necessary cleaning program modifications. It will also include ongoing testing to verify compatibility with larger tanks, where more surface area cleaning coverage is required.

Filler CIP Modifications

AE's filler machines – the equipment that fill bottles and jugs with milk product – utilize a programmed CIP cycle for cleaning and sanitizing after each product run. During the internship it was observed that the timed CIP cycle was overflowing one of the filler's product holding bowls and all excess water was running to the ground before the timed cycle switched to the next step. A simple programming modification reduced the timed cycle to the correct amount of time it takes to fill the bowl, saving water and improving CIP process efficiency.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
PRODUCT RINSE MODIFICATIONS	$19,588	1,144,521 gallons 44,220 kWh 281 therms	IN PROGRESS
CIP TURBIDITY SENSORS	$7,954	611,615 gallons	RECOMMENDED
ROTARY SPRAY HEADS	$5,357	411,861 gallons	RECOMMENDED
FILLER CIP MODIFICATIONS	$285	21,920 gallons	IN PROGRESS

CASIE MEYER

SCHOOL: The University of Iowa
MAJOR: Environmental Engineering

BURKE MARKETING CORPORATION – HORMEL FOODS

NEVADA

COMPANY PROFILE:

Burke, a subsidiary of Hormel, manufactures fully-cooked meat products with many applications, including restaurant or cafeteria service, and at-home cooking. Burke is headquartered in Nevada, Iowa, and employs about 500 people. The facility uses two plants to produce over 1,200 products. Production starts when raw meat is received. The raw meat is ground, then spices are added, and the meat is cut into the correct shape. The meat is then cooked on one of five oven lines. After this, the meat is frozen, bagged, boxed, labeled, and shipped.

PROJECT BACKGROUND

The plant utilizes a wastewater treatment facility to pre-treat wastewater, which can take two routes. First, the greasy water generated from the cooking process is pumped to a grease decanting tank. The wastewater is held, grease and water separate, and the water can be drained and undergo the facility's treatment. Second, water that's wasted throughout the plant goes directly to the treatment facility. In treatment, wastewater undergoes solids removal, pH treatment, coagulant addition, and aeration. This separates, binds, and removes contaminants. With these treatment processes, the plant struggles to reduce Carbonaceous Biochemical Oxygen Demand (cBOD) and stay below the city of Nevada's limits. cBOD is a measure of the oxygen required to remove organic pollution from water.

INCENTIVES TO CHANGE

The plant's discharged, treated water regularly exceeds the city's cBOD limits. cBOD comes from complex organic materials, like sugar or lard, breaking down into carbon dioxide and water. The amount of organic matter processed by the plant's wastewater treatment results in the opportunity for excess cBOD being discharged. Wastewater is collected and a composite sample is tested daily. Composite wastewater samples make it difficult to pinpoint specific sources of high contaminants. cBOD exceedances represent a significant monetary cost for the Burke plant. Reduction of these would represent both significant savings and positive environmental impact. cBOD reduction means reduction of organic waste, decreased energy use from treatment, improved water quality, and increased plant sustainability.

RESULTS

This project consisted of two parts. First was pinpointing the source of increased cBOD. To determine trends from the plant's historical wastewater data, the daily cBOD and oil/grease data were analyzed to determine the number and magnitude of exceedances per month. Additionally, for the last two years, the daily cBOD measurements were plotted against the pounds of product, pounds of meat, and pounds of spice produced. The graphs were created with data from all the products, and then broken down by product type (beef, pork, poultry, and mix). This suggested no correlation between product type, pounds of product, pounds of meat, or pounds of spice with excess cBOD. For each month, the daily cBOD was also plotted against the daily Total Suspended Solids (TSS) and Total Kjeldahl Nitrogen (TKN). These showed much stronger correlations with cBOD, so it's possible that treating TKN/TSS will reduce cBOD.

Specific product samples needed to be analyzed to pinpoint the source of cBOD. To do this, the greasy water captured directly from oven lines was sampled. Each sample was tested

for TSS, TKN, and chemical oxygen demand (COD). COD is similar to cBOD, but they differ in sources. To account for the differences in cBOD and COD, the plant's historical COD data was correlated with cBOD data. Fifty-four products were sampled (13 beef, 27 pork, eight mix, six poultry). Significant examination of each product was done. For each product, an ingredients list was compiled, and product yield was analyzed. This information was used to categorize the sampled products. These categories helped determine what products/ingredients were contributing to excess cBOD. The test results show that there are a few product-based cBOD sources. These sources include products with a high cooking yield, products with water as an ingredient, Italian seasoning blends, pork products, and the ingredients sodium phosphate and corn syrup solids. The plant's decanting operation is a known source of excess cBOD, but is not product-based.

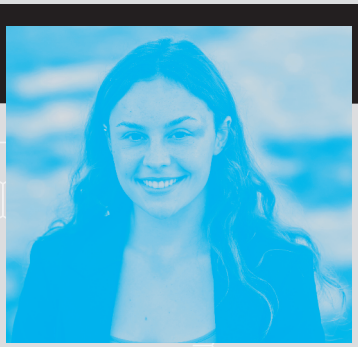
The second part of this project was determining methods to remove excess cBOD from the plant's wastewater. This was done through conversations with the plant's operators, examination of the current wastewater treatment facility, and outside research. cBOD represents the amount of substances in wastewater that are oxidizable. This means they consume oxygen and cause oxygen demand. To remove BOD, the oxidizable substances in the water must be oxidized with oxygen that's added to the water.

Hydrogen Peroxide Addition

The most efficient way to remove cBOD is adding an oxidizing chemical directly into the wastewater. One of the least expensive and strongest oxidizers is hydrogen peroxide (H2O2). H2O2 immediately releases dissolved oxygen into water and decomposes completely into hydrogen and oxygen, so it does not generate by-products. H2O2 completely oxidizes cBOD, and reduces TSS by about 10 percent and TKN by about 20 percent. The best location for injection is the pipe that takes the decanted water to the plant's wastewater treatment facility. The next-best location is directly into the effluent tank. Adding to the decanted water gives operators more control over the dosing effects. Operators would require minimal training, and the process would require minimal monitoring, because it is similar to the plant's current chemical addition processes. A few steps must take place before implementation. Communication must happen with the city of Nevada to ensure that adding H2O2 into the wastewater stream follows regulations. H2O2 must be tested on a large scale to ensure it works in practice at the site. If it works in practice, then the cost from exceedances would be eliminated. The cost from surcharges will decrease proportionally to the amount of cBOD, TSS, and TKN removed. Safety information sheets of the specific H2O2 purchased must be obtained.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
HYDROGEN PEROXIDE ADDITION	$39,556	56,890 lbs. cBOD Exceeded 27,612 lbs. TSS Exceeded 43 lbs. TKN Exceeded 97,940 lbs. cBOD Surcharged 3,763 lbs. TSS Surcharged 83 lbs. TKN Surcharged	RECOMMENDED



AVERY VEST
SCHOOL: The University of Iowa
MAJOR: Chemical Engineering

CF INDUSTRIES PORT NEAL COMPLEX

SERGEANT BLUFF

COMPANY PROFILE:

CF Industries, founded in 1946, is the leading global manufacturer and distributor of ammonia fertilizer products. Headquartered in Northbrook, Illinois, the company operates nine manufacturing plants and 23 distribution terminals serving customers across North America, Europe, and other international markets, producing 10.3 million tons of product per year.

The Port Neal facility employs approximately 270 people and operates 24/7, producing solid and liquid ammonia fertilizer, urea liquor, and diesel exhaust fluid (DEF). CF Industries operates with a strong commitment to environmental and product stewardship, manufacturing their products in an efficient and environmentally responsible manner.

PROJECT BACKGROUND

At CF Industries, the intern focused on assessing the water treatment facilities and identifying opportunities for improvement within the process. Ammonia production consumes water in two forms, steam generation with high purity water and cooling water usage. The intern was assigned with developing a baseline of the utilities and chemical costs per one million gallons of water in both of the site's ammonia plants. In collaboration with several departments, the information gathered identified areas of improvement and cost reductions in both the chemical treatment program and the cooling towers.

INCENTIVES TO CHANGE

CF Industries seeks to strengthen existing business by investing in clean energy initiatives that focus on significantly reducing the carbon emissions associated with the production of ammonia. The company looks to invest in projects that optimize their processes and reduce material consumption. The water treatment process and water consumption are areas where the company believes there are opportunities for savings. CF's commitment to the environment strengthens the business in the long term and creates new growth opportunities that support the global energy transition.

RESULTS

Install Reverse Osmosis Unit in Ammonia II

It was determined that the largest cost of water treatment is in making demineralized water. Currently demineralization train throughput is not meeting expectations and is reducing the lifespan and efficiency of the demineralization resin. Investing in filtration before water reaches the demineralization trains will reduce the cost of water treatment and improve the efficiency of both ammonia production facilities. A reverse osmosis unit was recommended and would further remove dissolved solids and impurities by pumping the water through a semi-permeable membrane which blocks out the impurities. The water is then much cleaner and ready to go through the ion trains. This additional filtration will significantly decrease the number of resin regenerations, significantly decreasing the use of caustic soda and sulfuric acid. It will also reduce the amount of resin changes required from every 5 years to 10.

FlexPro Treatment Plan in Ammonia II Cooling Towers

The cooling tower controls the level of blow down water based on the conductivity level which is limited by chloride concentration. The plant operates at low levels of chloride to prevent Stress Corrosion Cracking (SCC) which results in excessive water being blown down from the towers. The water usage could

be significantly reduced by changing the chemical treatment program to address the chloride limits on the system. FlexPro, an organic-based corrosion inhibitor, has been suggested as an alternative to the current chemistry program, which will continue to prevent fouling of the system, while also protecting it from SCC at higher concentrations of chlorides. The new chemical program will reduce the chemical treatment cost and show savings in the treatment of water that is saved in the blow down reduction. It also provides environmental benefits as it reduces the use of phosphorus and zinc emissions.

The recommended FlexPro program has been tested in the lab and has shown increased protection against SCC at up to double the current cycles of concentration and could be implemented in the North ammonia plant. If approved, the program will provide water and chemical savings and could be considered in the South plant as well.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL REVERSE OSMOSIS UNIT IN AMMONIA II	$1,025,655	49,320,000 gallons 1,700,000 lbs. sulfuric acid 2,300,000 lbs. caustic soda	RECOMMENDED
FLEXPRO TREATMENT PLAN IN AMMONIA II COOLING TOWERS	$173,839	157,000,000 gallons 18,250 lbs. phosphorus	RECOMMENDED

BRAM SUEPPEL

SCHOOL: The University of Iowa
MAJOR: Chemical Engineering, Math & Chemistry Minor

GELITA USA

SERGEANT BLUFF

COMPANY PROFILE:

Gelita, founded in 1875, is a leading supplier of collagen peptides, collagen, and gelatin. Gelita is a German-based company with 22 production plants and 11 sales offices worldwide. A strong emphasis is put on cooperation among the various locations, represented by ONE GELITA, a vision based on future goals to reach the top position in the market. The plant located in Sioux City, Iowa, is the largest single site gelatin factory in the world with around 300 employees. The facility produces gelatin from pig skin and bovine bone, as well as collagen peptides from bovine hide.

PROJECT BACKGROUND

Production of gelatin and collagen peptides produces wastewater that contains nitrogen in the form of protein. At the Sioux City Gelita plant, any wastewater produced during operation is sent through a lagoon system. Treatment of this wastewater and removal of nitrogen is necessary prior to discharge into the Missouri River. The focus of the project was to assess product losses associated with a wastewater stream leaving the fats, proteins, and minerals building, and investigate alternatives for recovery or removal of the nitrogen in the stream prior to discharge into the lagoon system.

INCENTIVES TO CHANGE

Increasing production at the Gelita facility has led to an increase in load on the wastewater lagoon system. A new wastewater treatment plant, scheduled to be built by the end of 2025, will replace the current lagoon system to keep up with the increasing load. However, as a treatment plant, there will be no profit coming from it. Therefore, ways to minimize the load on the facility are being investigated. The stick water presents an attractive opportunity for protein recovery and wastewater treatment reduction.

RESULTS

Pig skin residue from the gelatin production plant is sent to the fats, proteins, and minerals building. It is then separated into different components, a grease, solid, and an aqueous phase (stick water). The grease phase is processed further and sold. The separated solids are sent through a dryer and used for meal production. The stick water is combined with other waste streams, and is eventually sent through the lagoon system for wastewater treatment. The stick water stream has collagen proteins in the form of gelatin that have the potential to be recovered and used in the meal production. Recovery of the protein would increase meal yields while also reducing the nitrogen content of the wastewater.

Stick Water Recovery in Meal Process

A baseline assessment was performed on the current meal production process and the stick water content to identify limiting factors for recovery. It was found that the current process contains two pieces of equipment that may limit recovery, a paddle dryer and glycol cooler. Further analysis was performed on the current conditions and design conditions of the two pieces of equipment and found that both the dryer and the cooler are operating below their maximum design conditions.

The stick water is made up of 3-3.5 percent proteins, fats, and ash, with the majority of the protein being collagen. From the analysis of the equipment and the stick water, it was concluded that the additional capacity would be sufficient for recovery of the entire stream. Recovery of the stick water protein should be done through rerouting the stream to the current meal dryer.

Gelatin present in the stick water is causing the high collagen content of the protein. Drying of this gelatin may cause it to partially solidify at lower moisture contents which can create a sticky substance prone to buildup. Burning of the built up material may occur, causing burnt pieces to be processed as meal affecting the digestibility. To avoid this possibility, breakdown of the gelatin in the stick water is necessary. Addition of an enzyme into the stick water will allow for separation of gelatin strands, forming low molecular weight collagen peptides. Size exclusion chromatography was used for analysis of the average molecular weight of the collagen peptide content. Tests at different concentrations were performed and compared to a control and a collagen peptide standard. It was concluded that the tested enzyme would be effective at breaking down the gelatin. To add enzyme into the current process two options are given. The first is the implementation of a shear pump upstream in the process to breakdown large solids and allow for enzyme addition into an existing holding silo. The second is the installation of two tanks to hold the stick water and added enzyme. Estimates for installation of piping, electrical, transfer pumps, and tanks were acquired.

Evaporator Addition*

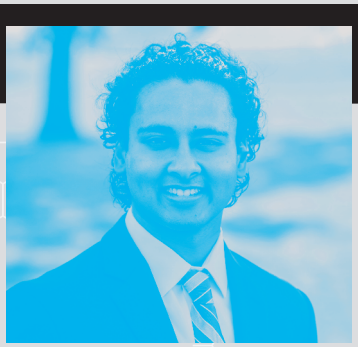
A high moisture content in the stick water will have a major effect on the heating in the current dryer. Reduction of the heating requirements necessary to recover the stick water will minimize additional costs and steam usage. An old evaporator is being replaced in the pig skin gelatin production plant. Analysis of the evaporator conditions indicate that it is unable to completely dry the stream but can function as an initial concentration step to reduce steam usage. Relocation and installation of the evaporator is a large initial investment, which also comes with a significant increase in electricity usage due to the pumps and other devices. Estimates for the relocation and installation of the evaporator and associated piping, pumping, and electrical were acquired.

Recovery of the stick water proteins into the meal process will reduce the nitrogen load in the wastewater, while increasing the meal yield. To do this, it is recommended that enzyme is added into the stick water stream via a set of holding tanks in order to breakdown the gelatin and prevent issues within the dryer. Additionally, it is recommended that the evaporator being replaced in the pig skin gelatin plant is relocated into this process for higher efficiency drying and steam reduction.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
STICK WATER RECOVERY IN MEAL PROCESS	$125,400	39 tons TKN	RECOMMENDED
EVAPORATOR ADDITION*	$47,500	114,400 therms 561,100 gallons	RECOMMENDED

**Dependent on implementation of stick water recovery*



ASH RAMESH
SCHOOL: The University of Iowa
MAJOR: Chemical Engineering

JBS SWIFT PORK

COMPANY PROFILE:

JBS was founded in 1953 and is the largest protein producer in the world. The JBS plant in Ottumwa, Iowa, is a major contributor to this title, harvesting 21,000 hogs every day and employing more than 2,500 people. The plant operates five days a week with a three-shift schedule, two production shifts followed by a sanitation shift. During peak season, additional Saturdays will be scheduled to meet production demands. JBS Ottumwa is dedicated to producing the highest quality product for its customers and reducing their environmental footprint.

PROJECT BACKGROUND

The main focus of this project was to identify areas for water reduction and water reuse without hindering the operations of the plant. The intern was also tasked with updating water usage data within the plant and establishing a baseline to prioritize improvement opportunities. The intern conducted lab studies and audits to collect data. Vendors and staff were contacted to further explore the viability of the recommendations from an economic and environmental standpoint.

INCENTIVES TO CHANGE

The large production capabilities of the Ottumwa plant mean large utility usage and potential environmental impact. A reduction in the plant's utility usage will save a significant amount of money and allow JBS to give more back to their community. JBS is committed to reducing their environmental footprint and is pursuing several long-term goals. These goals include converting organic waste materials into energy, stewarding natural resources on supplier and company owned farms, and reducing water usage by 15 percent. The company is also investing $100 million in research and development projects to assist its environmental efforts.

RESULTS

Air Cooled Condenser

The current heat exchanger that is used to cool the vapors from the rendering process and heats the water for sanitation is inefficient. The heat exchanger requires more water than the plant can hold in their 140° F water tanks. The extra water is treated for chlorine and sent to the river with no further usage in the plant. The installation of an air-cooled condenser in parallel with the heat exchanger will allow the plant to cool the rendering vapors without making additional 140° F water once the sanitation tanks are full. This will save the plant from purchasing water from the city as well as using sodium bisulfite to dechlorinate the water. A vendor has been contacted and is working with staff to determine the specifications for the air-cooled condenser's installation.

Rotary Drum and Screen Compactors

The feed being sent to the rendering cooker has a higher than ideal moisture content. This excess water requires the cooker to use more steam and time to render products. The current dewatering screens in place clog easily due to the high concentration of fats, oils, and grease within the feed. The installation of an internally fed rotary drum followed by two screen compacters will significantly reduce the moisture content of the feed. The reduction will also reduce the amount of rendering vapors being produced resulting in the reduction of 140° F water. A quote for this recommendation has been obtained and forwarded to management.

Reuse Effluent Water in Press

The sludge press is used to remove solids from the wastewater before it can be sent to the river. The press requires constant cleaning to avoid buildup. The press has a belt spray locked in one position, as well as a free, movable hose used for cleaning all other parts of the press. The press is not part of the production floor and therefore does not need to be food grade. It is recommended to use the effluent water produced from the wastewater process instead of 140° F water to clean it, reducing the plant's water usage. An existing pump has been used to reroute effluent water to these two cleaning applications and a ball valve has been installed for pressure control.

Automate Hair Hycor

The hair hydrolyzer heats removed hog hair and turns it into sellable animal feed. For optimal efficiency the hair must be dry when entering the hydrolyzer. To do this the plant has a dewatering Hycor that removes excess water. There are two water lines with several nozzles that constantly spray the screens of the Hycor to prevent hair buildup from reducing its efficiency. The lines are both active and operated manually. Installing solenoid ball valves to these lines will allow for the automation of these lines to balance the Hycor's efficiency as well as simultaneously reducing water usage. This project has been approved by management and is implemented.

Sanitation Equipment

Sanitation workers often sweep discarded meat with a hose instead of with a broom. This meat and water are then loaded into barrels with shovels and sent to the rendering department. This causes a high moisture content for the rendering feed

causing the cooker to require more steam. Using sifting shovels to scoop the meat will prevent extra water from being added to the rendering barrels. One shovel was purchased for testing purposes, management has approved more. Additionally, several workers don't use the correct nozzles on their hoses which causes an increase in water demand. Permanently attached nozzles will greatly reduce water use. Management is working on approval for this project.

Repair Equipment Wash Leaks

Workers use 180° F water stations to sanitize equipment. Due to high usage, these stations are prone to leaking. Because these stations use 180° F water, the leaks cost the plant both the cost of the and the cost of the steam used to heat that water. This makes fixing these leaks a priority. Three leaking stations have been identified and reported to maintenance to be repaired.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
AIR COOLED CONDENSER	$119,373	28,822,575 gallons 55,157 lbs. sodium bisulfite 31,155 kWh	RECOMMENDED
ROTARY DRUM AND SCREEN COMPACTORS	$138,445	348,614 therms 3,583,893 gallons 6,858 lbs. sodium bisulfite	RECOMMENDED
REUSE EFFLUENT WATER IN PRESS	$29,099	3,472,464 gallons	IMPLEMENTED
AUTOMATE HAIR HYCOR	$35,543	4,241,355 gallons	IMPLEMENTED
SANITATION EQUIPMENT	$55,926	3,439 therms 6,527,980 gallons	IN PROGRESS
REPAIR EQUIPMENT WASH LEAKS	$15,533	8,140 therms 1,508,472 gallons	IN PROGRESS

AMAN CHAUDHARY

SCHOOL: Augustana College
MAJOR: Mechanical Engineering

JBS USA, LLC

MARSHALLTOWN

COMPANY PROFILE:

JBS Foods is the largest meat processing company in the world, starting operations in 1953. JBS has its corporate office in São Paulo, Brazil, and offers a wide variety of quality, safe, and sustainable meat products across the world. The Marshalltown, Iowa, plant produces Swift Premium and La Herencia pork brands. The pork processing facility in Marshalltown runs 24/7 with three shifts, two production shifts and one sanitation shift, processing about 23,700 hogs daily and employing 2,394 team members.

PROJECT BACKGROUND

One of JBS's largest utilities is natural gas. The intern was tasked with assessing the steam system to improve efficiency and reduce the costs associated with steam generation in the facility. The intern completed a comprehensive assessment and evaluation of the plant's steam generation, supply, and usage, as well as operating costs. After completing the baseline assessment, the largest natural gas users were identified and prioritized based on cost and the amount of steam lost. The intern then explored recommendations to reduce the amount of steam used in various applications to reduce the consumption of natural gas used at the plant while cutting costs.

INCENTIVES TO CHANGE

While working on the intern project at one of the JBS's units in Marshalltown, it is essential to consider the strategic initiative that targets the improvement of energy efficiency and environmental aspects. By identifying and eliminating the unwanted steam system losses, fewer leaks in the steam system and less heat loss will occur, thus increasing the efficiency of the whole system. Increased efficiency reduces production costs and conserves natural resources, contributing to a more sustainable food product.

RESULTS

Steam Vacuums Improvement

Steam Vacuums (Steam Vacs) at the facility are used to cleanse the pigs with steam jets to ensure proper sanitation before further processing of the hog. Currently, the steam vacuums used in the Cutting Department are inefficient and costly in terms of energy use and consume around 90,000 pounds of steam per year. It is recommended to replace the existing Steam Vacs in the Cutting Department with more efficient models. Replacing the steam vacuums with newer, energy efficient models will decrease energy usage, save steam usage, decrease operating expenses, increase efficiency, and support JBS's sustainability initiatives. Newer models are going to have improved insulation and controls, and could potentially use renewable energy, depending on the model that is purchased. This upgrade has been approved by management and will be completed by the end of 2024.

Cooker Unit Improvement

The heating cookers act as the major appliances in the processing steps of many products originating from hogs. The heating cookers can heat up to a maximum temperature of 366°F, which allows the meat product to be well cooked, sterilized, and to undergo other thermal changes that are needed in the process of converting hog derived raw materials into the final products. It is recommended that the company upgrades the cooker unit in the rendering department due to the problems with steam leaks and performance. Flow meters will be installed to control steam usage, which will enhance efficiency,

save costs from steam leaks, and cut out waste. Also, the grease flow controller housing will be redesigned and a preventative maintenance plan should be followed by maintenance staff after the upgrade. All of these changes will help reduce resource use, increase efficiency, and contribute to JBS's sustainability goals. The project has been recommended and the management team has all information to move this recommendation forward.

Steam Leak Repair

The Hair Hydrolyzer is a continuous steam unit, aimed at softening and effectively cooking the hair with steam. It is recommended to repair the steam leak in the rendering department. The Hair Hydrolyzer, which remains crucial for the processing of hog hair, periodically leaks steam from the unit. A preventative maintenance plan should be put in place that provides inspection, early repair, and modern methods of leak detection. Employing expansion joints, readjusting the supports of pipes, and replacing dual valve systems with fixed valves and separators will help in avoiding leakage and erosion. Using these additional components will reduce maintenance and steam leak costs and improve the working of the systems. The plant engineer has started to perform periodic check-ups to monitor the implementation's progress and will continue to be accountable for the implementation of this recommendation.

Fisher Valve Improvement

The Dehair Unit is a piece of equipment with rotating rubber beaters that uses steam to heat the equipment to a standard temperature of 139°F. This equipment guarantees adequate hair elimination from the skin of the hog using hot water immersion and mechanical agitation. If needed, hogs go through several cycles on the Dehair Unit to obtain a satisfactory level of cleanliness. The fisher valves in the dehair unit have steam overflow and leaks. It is recommended to change the fisher valves in the dehair unit to reduce the amount of steam that needs to be generated and to improve operation efficiency. Once the valves are replaced, they should follow a preventative maintenance schedule by the maintenance staff. This project is recommended and is pending management approval.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
STEAM VACUUMS IMPROVEMENT	$680,724	1,053,653 therms 19,800,000 gallons	IN PROGRESS
COOKER UNIT IMPROVEMENT	$616,586	1,149,428 therms 20,500,000 gallons	RECOMMENDED
STEAM LEAK REPAIR	$11,414	2,298,857 therms 160,000 gallons	RECOMMENDED
FISHER VALVE IMPROVEMENT	$11,782	604,755 therms 17,500 gallons	RECOMMENDED

AUSTIN JONES
SCHOOL: The University of Iowa
MAJOR: Chemical Engineering

KEMIN INDUSTRIES

COMPANY PROFILE:

Kemin Industries is a biotechnology company and ingredient provider to a wide range of industries across the world. Kemin employs more than 3,000 people in more than 90 different countries. More than 600 staff people work at Kemin's Des Moines, Iowa, campus. Kemin is a science-based, data driven company. "Compelled by Curiosity" (Kemin's tagline), Kemin's scientists seek out sustainable customer centric solutions for the markets they serve. Kemin's continued growth will require sustainable process solutions as it provides high quality efficacious products to its customers.

PROJECT BACKGROUND

One of Kemin's largest products is a protein product manufactured in Verona, Missouri, and commonly utilized as a pet food ingredient. Raw materials are manufactured into an intermediate mixture (feedstock) with a high moisture content and then must be dried to a finished product powder using various dryer technologies. The drying process can be an energy intensive process, and optimization of the dryer steps has the potential for significant reductions in energy use, carbon emissions and operating costs. To aid in these efforts, the intern was tasked with optimizing the composition of the feedstock ready for the first drying step.

INCENTIVES TO CHANGE

Kemin's vision is to sustainably transform 80 percent of the people in the world with one of its products or services every day. To sustainably transform 80 percent of the people in the world, Kemin must efficiently and sustainably manufacture innovative products for its customers. Using a triple lens approach, (healthy people, planet, and company) Kemin's plan is to continually improve its products, services, and manufacturing practices to reduce its carbon emissions to reach its aspirational goal of net zero carbon emissions by 2050. One step among many is to optimize energy use in its drying technology in Verona, Missouri.

RESULTS

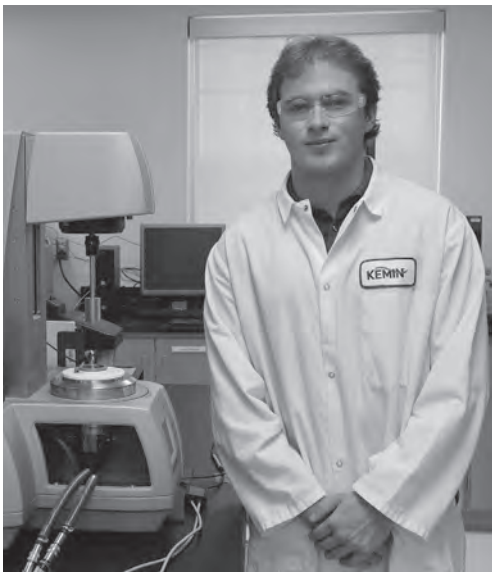
The optimization project started with extensive lab scale testing in Des Moines after fully understanding the production and drying process in Verona. The protein feedstock has a large moisture content that must be removed to create the dry powder finished product. In the current process, the high-moisture feedstock is sent to step one of the drying process. Approximately half of the moisture is removed in the first step. The remaining moisture is removed in the final step of the drying process, consuming significant amounts of hydrocarbon fuel sources. Step 1 of the drying process is a more energy efficient way of drying when compared to step 2 based on heat transfer calculations for both drying steps. If step 1 removes too much moisture, the protein feedstock will become highly viscous, impeding product flow rates. In order to identify opportunities for energy savings and optimizing the drying process, the feedstock itself was analyzed to identify possible ways of reducing its moisture content before reaching step 1 in the drying process.

Centrifugation Before Dryer Step 1

There is a large amount of water bound to the solids in the feedstock mixture. A mechanical solution to remove water would be desirable due to energy consumption and water reduction efficiency. If this solution is successful, dryer step 1 will also be more efficient and enable further moisture reduction before the feedstock mixture is moved to dryer step 2. Working

with the Kemin team, a hypothesis was developed proposing that centrifugation of the feedstock mixture would reduce moisture and other material in the feedstock. This process contributing to a higher viscosity level in the feedstock material. Removal of this material should reduce the drying time in dryer step 1 and 2. In order to prove this hypothesis, extensive lab-scale feasibility testing was conducted using centrifugation to reduce moisture and solids and calculate the potential energy savings.

First, a feedstock sample provided from the Verona plant was diluted down to the same level that would be seen in typical production operations. The sample was split into bottles and centrifuged, separating the liquid-heavy and solid-heavy fractions. A rotary evaporator was then used to concentrate the liquid-heavy fraction under vacuum pressure. The sample was concentrated down to a higher solids percentage while still flowing, but additional trials demonstrated that ultimately a slightly lower solids percentage seemed to achieve the best results. When recombined with the solid-heavy fraction, the feed to the last drying step would be more concentrated than what is observed currently.



A rheometer was used to evaluate the viscosity of samples with and without use of the centrifuge. The centrifuged sample exhibited a lower viscosity after the first drying step, which would cause reduced downtime and further cost savings.

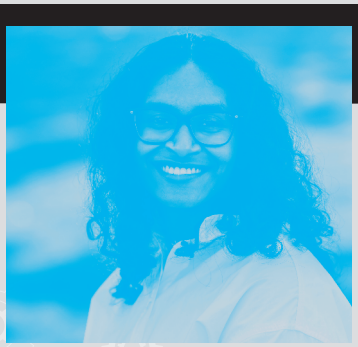
Since the data from the lab scale work was compelling, the next step was to scale and run pilot trials to confirm the lab scale data. A pilot scale centrifuge was commissioned for the next phase of the experimental work.

Other Drying Steps

Considering the data resulting from this study, Kemin may need to invest in drying technology better suited for higher viscosity feedstock flow or additional units to drive more moisture out of the feedstock before the final drying step. As a result, further savings could potentially be achieved if another evaporation step is added before the last dryer step. Dryer technology designs for the food industry are specifically designed to handle highly viscous and fouling material and would be readily adaptable to handling the feedstock manufactured in Verona. Even a moderate increase in the solids concentration of the feedstock could result in significant energy savings, but uncertainty remains over how much energy demand an evaporator unit like this would have. Additional research will need to be performed to determine the viability of adding a different type of evaporator to the process.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
CENTRIFUGATION BEFORE DRYER STEP 1	$44,473	65,659 kWh 83,654 therms 471 tCO2	RECOMMENDED
OTHER DRYING STEPS	TBD	TBD	FURTHER RESEARCH NEEDED



ANANYA SIVASHANKER
SCHOOL: Iowa State University
MAJOR: Mechanical Engineering

WOODWARD RESOURCE CENTER

COMPANY PROFILE:

The Woodward Resource Center (WRC) is an Intermediate care facility in Woodward, Iowa. Established in 1917, the facility houses individuals with physical and intellectual disabilities, while also treating those with other related disabilities. WRC works to prepare and support both children and adults to live in the community of their choice while also providing care and shelter to those who cannot take care of themselves. Their mission is to "provide high quality programs and services that protect and improve the health and resiliency of individuals, families, and communities."

PROJECT BACKGROUND

The Woodward Resource Center is undergoing a process of decentralizing their heating, ventilation, and air conditioning (HVAC) cycling system from a primary power plant. The intern was tasked with creating and implementing a plan for recommendations by conducting a thermographic assessment of campus structures and targeted equipment, aiming to improve energy efficiency and reduce utility costs. The project objective is to increase energy efficiency of the campus structures and provide supporting data for a comprehensive decentralization project at the Woodward Resource Center campus. The intern performed heat transfer calculations and established feasible options for the facility to implement for this process.

INCENTIVES TO CHANGE

The WRC is committed to improving their energy efficiency. The main method being used to cycle heating and cooling through the WRC's power plant is inefficient and expensive to maintain. Large amounts of resources are lost in the heating cycle as the system is prone to leaks and damage. Furthermore, many of the buildings and cottages at WRC are outdated and need updating. The facility intends on putting an emphasis on resolving air leakages and improving quality of building envelopes to ensure the most efficient outcome during this transition.

RESULTS

Install Thermal Curtains

Through thermographic surveying and performing calculations, the intern noticed significant heat infiltration being caused by the numerous amounts of windows in several buildings. One of the most significant was the Administration building: several long corridors of uninsulated windows contributed to high temperatures inside the building. Air conditioning (AC) units would run in rooms on either end of the building, however, would not be able to properly condition the space due to the high heat infiltration from the windows. Not only did the extensive number of windows cause unbalanced temperatures within the building, but also overworked the AC systems, contributing to more energy consumption during hotter temperatures. The intern proposes the implementation of thermal polyester curtains that will be able to block the sunlight from entering the corridors and therefore shield the interior of the building from excessive heat. This addition would allow for the interior temperature and air to be better controlled. Furthermore, thermal curtains are adjustable and will be able to be moved or folded in the case that the windows need to be open.

Replacement Windows

Studying the building structures, the intern noticed several older windows still in use with some of the buildings at WRC. The facility is currently in the process of replacing these windows, however the progress is affected by budget considerations.

Through research and calculating heat loss from several of the types of windows on campus, it was shown that the oldest, single pane windows have the least amount of thermal resistance as compared to others. Although the replacement process is already in progress, it is proposed that WRC prioritize window replacement for the decentralization process. Several buildings have many old or outdated windows and ideally, the campus will eventually replace all the old windows with newer double pane windows. Since this process is slow, it is recommended to prioritize window replacement in the Administration building, Birches (office building), and Linden Court (Woodward Academy) first, as these buildings contribute the most to overall heat loss. The replacement of these windows with newer ones will provide more overall thermal resistance to the envelops of each building, and therefore use less energy to heat or cool the interior spaces.

Added Insulation

Performing heat transfer calculations revealed a significant portion of overall heat loss was the result of poorly insulated walls in the cottages on campus. Further thermographic surveying showed that much of the insulation in the walls has collapsed due to water infiltration. The current insulation, being only fiberglass, does not provide enough internal protection to the building from heat infiltration or heat loss. This is detrimental to these buildings especially during extreme hot or cold weather. Because of the poor heat resistance, the campus needs to consume more energy to maintain the internal temperature of the cottages. To address this issue, the intern recommended installing an extra layer of insulation along with the already existing material. The specific insulation recommended for this change is extruded polystyrene foam which specifically has a high thermal resistance value and is also moisture resistant. As recommended, extruded polystyrene foam insulation would be installed on top of the already existing fiberglass insulation, being imbedded in the layers of material used in this wall. This added insulation would then provide more thermal resistance to the cottages, giving these buildings better protection against extreme hot and cold conditions.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL THERMAL CURTAINS	$5,458	9,801 therms	RECOMMENDED
REPLACEMENT WINDOWS	$5,112	9,181 therms	IN PROGRESS
ADDED INSULATION	$4,531	8,137 therms	RECOMMENDED

POLLUTION PREVENTION: STUDENT APPLICATIONS

STUDENTS! Join the P2 Intern Program in 2025!

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 2024 and Spring 2025 classes

Selection of 2025 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 19-August 8) or co-ops for 28-weeks (May 19-November 28) in 2025.

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

Application forms are available online at: CyHire, Handshake, or www.iowap2interns.com

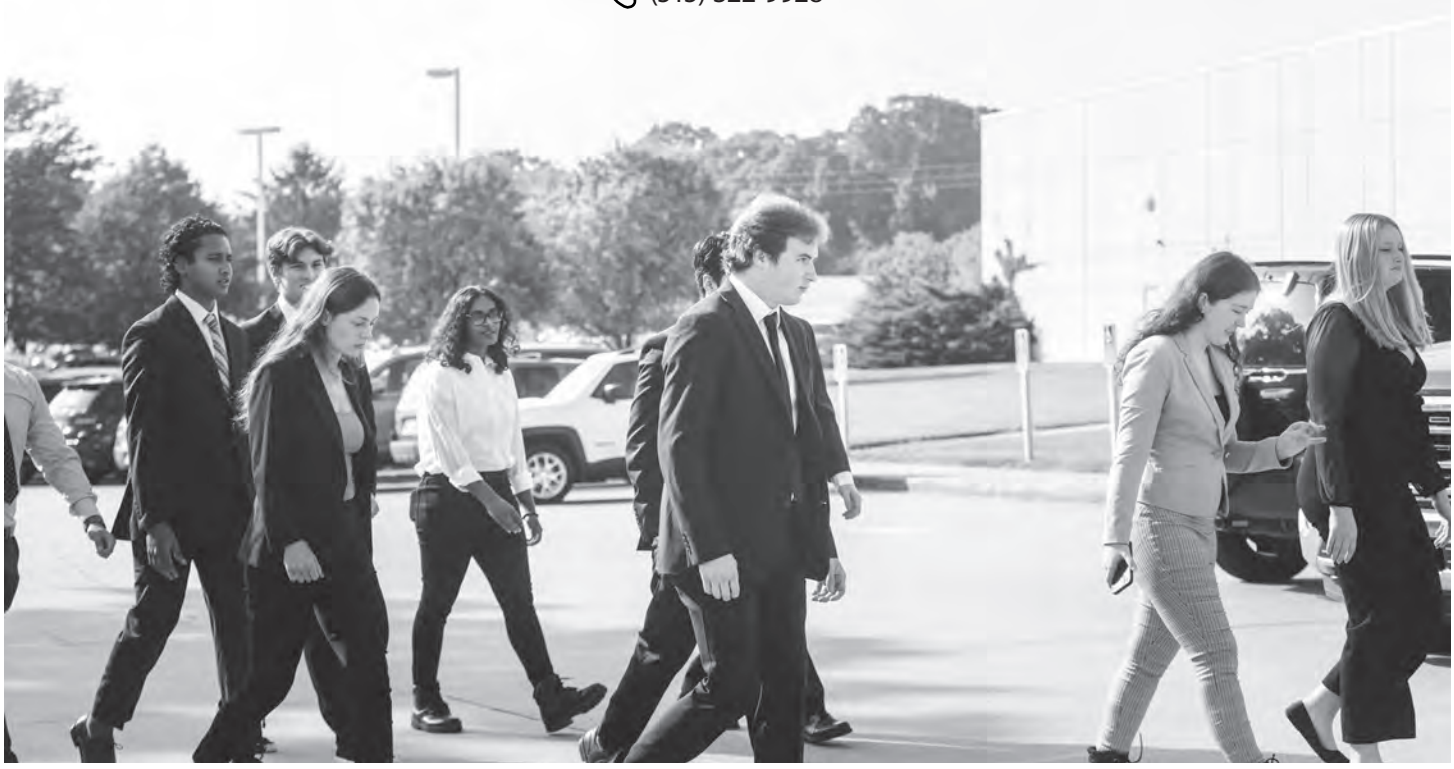
The Iowa Department of Natural Resources is an EEO/AA Employer

» SUBMIT APPLICATIONS TO:

Online through CyHire or Handshake

P2Services@dnr.iowa.gov

(515) 322-9928



POLLUTION PREVENTION SERVICES SERVES IOWA COMPANIES

Since 1990, hundreds of Iowa businesses, industries, institutions and governmental agencies have saved money, improved operational efficiency, and become environmental leaders by working with DNR's Pollution Prevention (P2) Services.

Our team of technical engineers provide no-cost, confidential, non-regulatory assistance to facility operators. Opportunities are identified that can improve your company or organization's bottom line while making positive environmental impacts.

Our services include:

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 $120.2 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.

P2 EQUIPMENT LOAN PROGRAM

Pollution Prevention Services has several pieces of monitoring equipment that are available to companies to assist in data collection to further their pollution prevention initiatives. For more information, visit our website.

2024 PROJECT INDEX

POLLUTION PREVENTION INTERN PROGRAM

CHEMICAL REDUCTION/REPLACEMENT

- CF Industries Port Neal Complex
- JBS Swift Pork

COMPRESSED AIR

- Ajinomoto Health & Nutrition North America, Inc. (2023)

ENERGY REDUCTION

- Ajinomoto Health & Nutrition North America, Inc. (2023)
- Ajinomoto Health & Nutrition North America, Inc. (2024)
- Gelita USA
- Kemin Industries
- JBS USA, LLC
- JBS Swift Pork
- Woodward Resource Center

HEAT RECOVERY

- JBS USA, LLC

PROCESS IMPROVEMENT

- Ajinomoto Health & Nutrition North America, Inc. (2023)
- Ajinomoto Health & Nutrition North America, Inc. (2024)
- Anderson Erickson Dairy - Shrink Reduction
- Anderson Erickson Dairy - Water
- Kemin Industries
- CF Industries Port Neal Complex
- Gelita USA
- JBS Swift Pork

SOLID WASTE MANAGEMENT

- Gelita USA
- JBS Swift Pork

WASTEWATER

- Burke Marketing Corporation - Hormel Foods
- CF Industries Port Neal Complex
- Gelita USA
- JBS Swift Pork

WATER USE REDUCTION

- Ajinomoto Health & Nutrition North America, Inc. (2023)
- Ajinomoto Health & Nutrition North America, Inc. (2024)
- Anderson Erickson Dairy - Water
- CF Industries Port Neal Complex
- Gelita USA
- JBS Swift Pork
- JBS USA, LLC

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