WORKING TOGETHER TO ACHIEVE ECONOMIC AND ENVIRONMENTAL RESULTS

POLLUTION PREVENTION

INTERN PROGRAM CASE SUMMARIES





2019

www.iowap2services.com

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DIRECTOR'S NOTE

Since 2001, the DNR's Pollution Prevention (P2) Intern Program has teamed with Iowa colleges and universities, businesses and institutions, and government to reduce environmental impacts and preserve our natural resources.

Many of the host companies with this program are spread throughout rural Iowa, where they are the backbone of their communities. Often the largest employer in the area, the success and economic health of the company directly impacts a community's quality of life. Key economic metrics like increased employment opportunities, increased business profitability and long term growth stability are top priorities, and these are possible when local companies operate at peak efficiency. These same goals are at the heart of P2, and the services provided by the intern program. The benefits of more efficient utilization of natural resources and improved environmental performance are far reaching and can have lasting effects on Iowa communities.

Additionally, most companies have aggressive water and energy reduction goals as part of their sustainability plans. Companies use water in production, cleaning and sanitation, and mechanical systems. While city water itself is relatively inexpensive, associated costs to heat, cool, pump, and treat the water can add up quickly. Compressed air and steam systems are examples of mechanical systems that require ongoing preventative maintenance plans to maintain optimum operating efficiency. Identifying and correcting inefficiencies in these and other operating and production systems can significantly improve a company's bottom line and reduce pollutants affecting air and water quality.

For host companies of the P2 Intern Program, upper level engineering students provide a fresh perspective and an extra set of hands to explore ways for the companies to use fewer resources and become more efficient. Companies are often aware of inefficiencies in their processes but do not have the time or staff to dedicate to data collection or researching options. The interns, along with resources provided by their P2 advisers, work to identify the source of inefficiencies in the company's systems and apply pollution prevention or source reduction strategies to develop innovative solutions.

Companies have reported more than $91.06 million in savings and implementation is ongoing. I commend each of the host companies, the interns, and the Pollution Prevention Services team for their dedication to improving the quality of life in Iowa and ensuring a legacy for future generations.

KAYLA LYON, Director
Department of Natural Resources

TOTAL IMPLEMENTED SAVINGS 2001–2019

POLLUTION/WASTE REDUCTION & COST SAVINGS FROM IMPLEMENTED INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	5,057,922,241	gallons	$11,380,897
ENERGY	394,933,614 2,661,017 13,131,084	kWh *MMBtu therms	$22,400,302 $9,719,592
CHEMICAL REDUCTION AND HAZARDOUS WASTE	8,668	tons	$15,658,585
SOLID WASTE	173,275	tons	$16,526,519
SPECIAL WASTE	75,681	tons	$943,275
MERCURY ABATED	42,817	grams	
OTHER			$14,439,234
			TOTAL: $91,068,404

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

2001–2019 GREENHOUSE GASES & CONVENTIONAL AIR POLLUTANTS FROM IMPLEMENTED PROJECTS

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS							GREENHOUSE GASES DIVERTED IN METRIC TONS				
NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO	CO_2	CH_4	N_20	CFC	$MTCO_2e$
8.44	501.90	83.58	55.78	917.69	89.81	255.61	232,081.70	57,462.53	2,966.21	1,589.91	294,020.85

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

2019 INTERN PROGRAM EXECUTIVE SUMMARY

Eleven upper-level engineering students from Iowa colleges and universities served as interns with the 2019 Iowa Pollution Prevention Intern Program. The intern program is an extension of DNR's Pollution Prevention Services, a non-regulatory program that offers confidential technical assistance to Iowa businesses and industries. Interns are placed at host facilities to analyze the company's waste streams and to research and recommend process improvements that will lower operating costs while reducing negative environmental impacts.

Ten interns worked full-time at their host company from May to August, exploring and evaluating projects that could dramatically reduce water and energy use, and solid and hazardous waste by applying methodologies to improve system and process flows. Projects were recommended that could save the companies more than $2.87 million dollars annually and curtail associated air emissions and greenhouse gases. Implementation is complete or in progress for projects that will generate $294,421 in savings. Multiple projects in 2019 also had a risk reduction factor to them, which is difficult to quantify, but extremely valuable to protecting the environmental health and safety of the employees.

The program continues to offer both 12-week and 24-week project opportunities. The project at Cobham highlighted in the following pages outlines the first 12 weeks of a 24-week project that will continue into November 2019. The intern is seeking source reduction opportunities for chemical and solid waste streams and providing implementation support for approved solutions. This intern is able to conduct more in-depth research, evaluate the impacts of process changes and make adjustments as needed. These extended internships also allow more opportunity for interns to implement approved projects. While a 24-week internship is not feasible for all companies or interns, it has proven to be a beneficial option for addressing a larger scope and more complex projects.

Whether it's to meet corporate sustainability goals or to provide a cleaner environment, companies are continually seeking to increase efficiency in their operations. These 2019 case summaries highlight the ongoing pursuit of environmental stewardship and sustainability that are key to the economic health of the companies and their surrounding communities.

SAVINGS 2019 THROUGH AUGUST

ACTUAL POLLUTION/WASTE REDUCTION & COST SAVINGS FROM INTERN PROJECTS

CATEGORY	REDUCTION	UNITS	COST SAVINGS
WATER CONSERVATION	13,092,255	gallons	$109,254
ENERGY	1,361,195 19,712 150,661	kWh **MMBtu therms	$110,573 $51,788
CHEMICAL SUBSTITUTION/ REDUCTION AND HAZARDOUS WASTE	20.64	tons	$7,497
OTHER			$15,309
			TOTAL: $294,421

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

2019 GREENHOUSE GASES & CONVENTIONAL AIR POLLUTANTS

CONVENTIONAL AIR POLLUTANTS DIVERTED IN METRIC TONS

NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO
0.047	2.513	0.428	0.274	4.668	0.540	1.481

2019 GREENHOUSE GASES DIVERTED IN METRIC TONS

CO_2	CH_4	N_20	CFC	$MTCO_2e$
1,184.480	158.626	17.884	7.988	1,368.613

NOTE:

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

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

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

STUDENT PERSPECTIVES

Dayton Wright
Iowa State University

"On a personal level this is certainly the largest problem I've had to solve in terms of scale, accountability, and impact. Having solved the problem, I feel more confident in myself as both an engineer and a person."

Lisa Eischens
The University of Iowa

"The experience is what you make of it, so if you work hard independently, you can learn a lot and accomplish a lot in a short period of time."

Chris Berg
Iowa State University

"You are in control of the direction and outcomes of your internship. Any recommendations that you make could have huge economic and environmental impacts on the company far after you leave."

COMPANY TESTIMONIALS

"I would highly recommend this program to other companies. Not only does it give the host company a chance to finish something they may not have the time or resources for, it gives the students real time experience and helps prepare them to hit the ground running once they complete the degree work."

— Kevin West – EH&S Coordinator for Rosenboom

"This program is an excellent resource to employers in the State of Iowa. Each year, our assigned intern has provided us with results that have helped us improve our sustainability programs and environmental management. "

— Brian Herbst, Plant Safety Manager for Smithfield Foods

"Excellent program. Our intern delivered above and beyond our expectations."

— Kimberlie Bumgardner – Environmental Manager for Tyson Foods Inc. Hillshire Brands

» Join the P2 INTERN PROGRAM in 2020!

FOR COMPANIES

Pollution Prevention Services is currently accepting requests for 2020 intern projects. Companies must submit a project request that identifies a focus project and outlines the desired objectives and impacts. Company project requests must be submitted by **December 2, 2019** to be considered for a 2020 intern placement.

Project requests will be reviewed upon receipt and companies contacted within two weeks for review and clarification. 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 2020.

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

FOR STUDENTS

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 2019 and Spring 2020 classes

Selection of 2020 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 18-August 7) or for 24-weeks (May 18-November 6) in 2020.

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

SUBMIT PROJECT REQUESTS & APPLICATIONS TO:

DANIELLE ROSELAND
Iowa Dept. of Natural Resources
Pollution Prevention Intern Program Coordinator

502 East Ninth Street,
Des Moines, IA 50319-0034

Phone: (515) 725-8363
Danielle.Roseland@dnr.iowa.gov

STUDENT APPLICATION & BUSINESS REQUEST FORMS ARE AVAILABLE ONLINE AT:

www.iowap2interns.com

Forms may be submitted electronically, faxed or mailed.

THE IOWA DEPARTMENT OF NATURAL RESOURCES IS AN EEO/AA EMPLOYER

CAMBREX

LISA EISCHENS
Major: Chemical Engineering
The University of Iowa

COMPANY PROFILE

Founded in 1981, Cambrex is the small molecule company that provides drug substance, drug product and analytical services across the entire drug lifecycle. The company has a presence in thirteen locations globally and is one of the leading Contract Development and Manufacturing Organizations (CDMO) in the market. With an accelerated demand in the market, Cambrex continues to use their technologies and expertise to meet customers' needs for small molecule therapeutics. Cambrex's plant in Charles City, Iowa, employs approximately 375 people.

PROJECT BACKGROUND

Cambrex Charles City has been monitoring their usage of makeup water to the cooling tower system since 2018 to identify uncontrolled losses. Loss of cooling tower water (CTW) increases water and chemical usage, and the volume which must be treated at the on-site wastewater treatment plant (WWTP). Changes in chemical levels can also decrease heat transfer efficiency when cooling equipment. The intern was tasked with locating areas of CTW loss throughout the production loop and evaluating solutions to reduce water and chemical usage in the system. Opportunities to improve the efficiency of the plant's steam system were also analyzed.

INCENTIVES TO CHANGE

As a member of the Society of Chemical Manufacturers and Affiliates (SOCMA), Cambrex subscribes to an environmental management system known as ChemStewards®. As part of this program, Cambrex is dedicated to continuous improvement in environmental performance and strives to use resources efficiently and minimize waste. For the second consecutive year, Cambrex's EHS department partnered with the Iowa Department of Natural Resources' Pollution Prevention Intern program. This year's water reduction project supports the company's commitment to operational excellence and sustainability.

RESULTS

A mass balance was performed on the CTW system, including flow rates and estimated evaporation and blowdown rates. The CTW flow was mapped throughout the entire plant to locate drainage points for potential losses. To help identify where losses were occurring, water samples were taken at various points in the CTW system and were tested for evidence of cooling tower treatment chemicals.

Repair Chiller Overflow: One source of CTW loss was traced to an overflow on a chiller system. This overflow is at its highest rate during the summer months and the majority of the drainage could be conserved by repairing the equipment. Controlling this overflow will lead to a higher recirculation rate through the treated cooling tower loop and lower the required flow of makeup water. This equipment is integral to production, therefore the repair should be scheduled during the annual maintenance shutdown period.

Switch Wet Seal to City Water: Another source of CTW loss was identified from a mechanical wet seal which requires a continuous water flow. The seal is supplied with CTW which is not currently recycled back into the loop. This water does not need to be pre-treated. Re-piping to supply single pass city water to this equipment could reduce associated treatment costs of this continuous flow.

Revised Procedures: Incorrect order of operations for heating, cooling, and drain valves on equipment can lead to CTW loss. Updates were made to procedures to ensure valves are opened and closed in the correct sequence. This change will decrease the frequency of excess losses in the work center with manually operated valves.

Return Temperature Probe: A temperature probe installed on the return pipe to the cooling tower would allow continuous recording of the temperature drop across the towers, which varies with weather and production changes. A thermal well already exists on this pipe, where a temperature probe may be installed with a recorded output. Monitoring evaporative losses and cooling loads for the CTW system would enable personnel to see changes in tower operation and makeup water usage and make adjustments or repairs as needed, leading to reductions in the annual water usage.

Cooling Tower Fan Automation: All cooling tower fans are currently operated on variable frequency drives, but must be manually turned off when the cooled water reaches a certain low temperature, then turned back on when the temperature increases. The purpose is to keep water from overcooling in the winter, which prevents freezing and helps to maintain the minimum temperature required by the HVAC chillers. This operation could be automated so fans turn off when the water temperature reaches the low set point and turn back on when the temperature surpasses the low threshold. This change would require a simple adjustment of the current instrumentation, and could eliminate the necessity of manual shutoff and startup by the mechanics and could also reduce the risk of operator error.

Pipe Insulation: Steam and condensate piping was traced in two production work centers. Maps were created and provided to a contractor to install new pipe insulation where previous insulation was missing or damaged. Insulation is necessary on all steam and condensate pipes to protect employees in work areas, and to reduce energy losses.

Steam Leaks and Vents: Visible steam leaks and failed traps were identified for repair in the production work centers. Venting steam pipes were also identified, including one where losses came from inactive equipment. This steam loss can be eliminated by capping the supply to the equipment. The other vents are attached to condensate return stations, so it is recommended a full steam trap audit be completed to repair failing steam traps in these systems. Repairing leaks and maintaining the steam system reduces energy, water, and chemical demands for the boilers.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Repair Chiller Overflow	$7,571	788,608 gallons of water 458 gallons of inhibitor	Recommended
Switch Wet Seal to City Water	$3,618	303 gallons of inhibitor	Recommended
Revised Procedures	$1,096	114,192 gallons of water 66 gallons of inhibitor	Implemented
Return Temperature Probe	$1,389	144,704 gallons of water 84 gallons of inhibitor	Recommended
Cooling Tower Fan Automation	–	Risk Avoidance	Recommended
Pipe Insulation	$4,060	10,528 therms	Implemented
Steam Leaks and Vents	$40,007	867,761 gallons of water 87,449 therms 23,691 lbs chemical	In Progress

CNH INDUSTRIAL AMERICA, LLC

JENNI KRONEMAN
Major: Mechanical Engineering
Iowa State University

COMPANY PROFILE
CNH Industrial was formed in 2013, following the merger of Fiat Industrial and CNH Global N.V. CNH Industrial designs, manufactures and sells the world's leading machines for agriculture, construction, commercial and specialty vehicles as well as engines for this equipment and for marine and power generation applications. The company has more than 64,000 employees, 66 manufacturing plants, and 54 research and development centers worldwide. The Burlington, Iowa, plant employs more than 400 people and manufactures dozers, tractor loader backhoes, tractor loaders, rough terrain forklifts, and three types of combine headers – corn, draper, and auger. CNH Industrial's commitment to sustainability is a long-term priority and a fundamental aspect of the day to day activities of its employees, its supply chain, and its logistic and manufacturing processes.

PROJECT BACKGROUND
The 2019 project at CNH Industrial was to research and quantify upgrades to the exhaust fans and make-up air units in a high use production building that would reduce energy usage. This data was then used to develop a schedule to implement the improvements in all buildings on-site and prioritized to maximize savings. The intern also completed an inventory of light fixtures used in each building and recommended appropriate efficiency upgrades for the work area. Similar to the exhaust fan project, an implementation plan was developed and prioritized to maximize energy and cost savings.

INCENTIVES TO CHANGE
CNH Industrial uses a program called World Class Manufacturing (WCM) which provides guidance for continuous improvement of operations. The goal of WCM is to eliminate all waste within the company including: time, material, operating and production waste, and utilities. The Burlington plant is also certified to ISO 50001 which provides another framework for energy improvements. In addition to achieving environmental goals, energy reduction projects offer opportunities to save money.

RESULTS
Exhaust Fan Timers – Building 52: Observations of the exhaust systems throughout the plant revealed most exhaust system equipment was running continuously. Building 52 was selected to be the priority for analysis based on its large number of welding stations. Welding produces fumes which need to be removed to maintain air quality. Building 52 has a relatively large number of exhaust fans compared to other buildings. The recommendation is to place controls on the exhaust equipment which would be integrated into the Facilities Computer. Once the installation is complete, the equipment would be programmed with an automatic on/off schedule to coincide with times operators are working in the area. This proposed schedule could reduce the annual run time of the exhaust systems by 50 percent.

The most direct benefit of this project would be electricity savings. When the fans automatically shut off overnight and on weekends, no additional electricity would be consumed. Another cost saving and environmental benefit is a reduction in natural gas usage. Through the colder months while the exhaust fans are running, warm air is continuously pulled from the building. During production hours, this is necessary because of welding fumes. However, during the off-shift hours, the fans pull heat out unnecessarily, causing excess natural gas to be consumed to maintain the building's set point. The controls would also allow for monitoring of the status of equipment, air temperature, and carbon monoxide levels from one centralized location. This would assist CNH Industrial in ensuring the air quality meets safety standards at all times for the operators.

Exhaust Fan Timers Expansion: After quantifying projected savings for Building 52, the intern investigated the exhaust fan systems in the other buildings at the Burlington plant. The intern took inventory of the fans, and calculated electricity and natural gas losses of the exhaust systems and makeup air units of each building. Prioritizing buildings with the highest savings potential, CNH Industrial has a clear implementation plan that will reduce energy usage and improve air quality across the plant while maximizing cost savings.

For each step of this implementation plan, CNH Industrial would need to install the controls and integrate the additional fans and scheduling into the Facilities Computer.

HID Replacement: CNH Industrial had previously replaced the majority of the high intensity discharge (HID) fixtures used in the plant. The goal was to save energy and decrease the fire risk from the heat produced by HIDs. The previous projects were a success, so the intern took an inventory of the remaining HIDs in use at the plant. Data logger equipment was used to obtain accurate run time information for each group of lights. This data was then used to project the energy and cost savings of replacing existing HIDs with light emitting diode (LED) fixtures and occupancy sensors.

LEDs use less than half the wattage of HIDs and produce significantly less heat. In addition to the significant energy savings, LEDs do not require regular ongoing maintenance. LED fixtures are also programmable so that CNH Industrial can customize the occupancy, dimming, and daylight harvesting parameters of each fixture. The occupancy sensors could further reduce energy usage by turning off or dimming the lights when no one is in the area.

Lighting Expansion: Multiple buildings contain fluorescent fixtures or LEDs without occupancy sensors. For all these buildings, the intern took inventory of the lighting types and run hours. From this data, the intern also developed a prioritized implementation plan to upgrade the remaining lighting at the plant. Once the expansions are complete, all buildings will contain LED lights and occupancy sensors. With

standardized LED lighting, maintenance could alleviate storage of multiple lamps and ballasts for maintenance and repairs.

The buildings with fluorescent fixtures would experience energy savings from a lower wattage fixture and shorter run times. The areas with existing LEDs already have low wattage fixtures, but the run times would be shortened by the addition of an occupancy sensor.

To implement each step of the lighting upgrade plan, fixtures and LEDs would need to be purchased and the installation scheduled.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Exhaust Fan Timers — Building 52	$51,280	481,756 kWh 29,516 therms	In Progress
Exhaust Fan Timers Expansion	$60,660	463,810 kWh 122,149 therms	Recommended
HID Replacement	$9,954	117,109 kWh	Recommended
Lightning Expansion	$194,856	2,292,424 kWh	Recommended

COBHAM

CHRIS DEBONDT
Major: Chemical Engineering
Iowa State University

COMPANY PROFILE

Cobham is an aerospace engineering company that works alongside some of the largest companies in the aerospace business, such as Boeing and Lockheed Martin. Cobham is headquartered in Britain with multiple locations across the United States. The Davenport, Iowa, site employs approximately 1,000 employees. Cobham is the world's leading supplier of critical control solutions, with its best known product as air-to-air refueling equipment. The quality of Cobham's products is critical to the safety of its customers. The company's mission statement "Every Mission Matters" reflects Cobham's commitment to producing only the highest quality products.

PROJECT BACKGROUND

Cobham is investigating potential solutions to reduce solid and hazardous waste streams at the Davenport plant. Applying source reduction and pollution prevention strategies could set the stage for achieving site reduction goals. A 24-week intern with the Pollution Prevention Program is providing dedicated support to research opportunities, consider impacts, and develop solutions for reducing these challenging waste streams. For solid waste reduction, the intern is evaluating online document storage and electronic documentation to reduce paper usage. Strategies being researched in the hazardous waste category include solvent recycling, potential chemical substitutions, and strategic purchasing practices.

INCENTIVES TO CHANGE

Cobham is becoming an industry leader in environmental awareness, and is striving to reduce their environmental impacts. Sustainability goals at the Davenport site include a 10 percent reduction in paper usage and waste, and a 2 percent reduction of hazardous waste produced onsite. Material classified as hazardous is costly both to purchase and to dispose of. Reductions in the use or disposal of this waste stream could reap significant benefits. In addition, documentation is a critical part of Cobham's processes. Identifying opportunities to reduce unnecessary printing and paper use could provide economic savings while also reducing environmental impact.

RESULTS

Solvent Recycling: Cobham is investigating solvent recovery and partnering with a waste disposal vendor that offers an option for offsite recycling in addition to safe disposal. Having an offsite option for recycling solvent would allow for spent solvent to be beneficially reused and reduce hazardous waste generated by the plant. Onsite solvent recycling was also considered, but available quantities and associated costs made this option infeasible. The intern will continue to investigate the best way to implement solvent recycling while factoring in all appropriate considerations including compliance, cost feasibility, and associated environmental impacts.

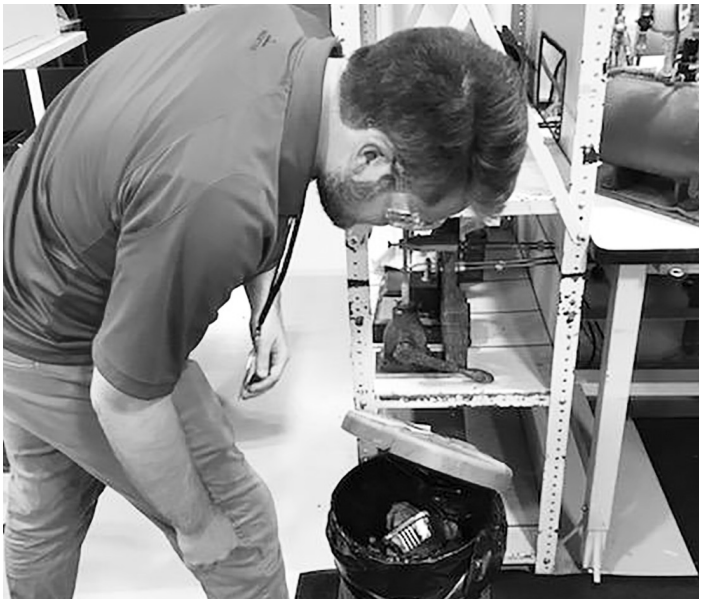
Chemical Substitution: Identifying effective, less toxic substitutions to hazardous chemicals offers environmental, health, and safety benefits that are difficult to quantify but of critical value to Cobham. The intern is researching possible substitutions for a number of hazardous chemicals used onsite. In one application being analyzed, a replacement option for a hazardous solvent is more expensive to purchase but could result in lower disposal costs. Also, because the new solvent is less volatile than the current one, there would be the potential for the wipe used to apply the solvent to be dampened less frequently, decreasing overall usage.

The intern is also investigating the possibility of switching a chrome conversion coating currently purchased in bulk to the same product but in a pen form. One advantage of using a pen form for delivery is a decrease in Foreign Object Debris (FOD). FOD represents anything extraneous in an employee's work area that is not going to be built into a part. Minimizing FOD is of the utmost importance to Cobham. In addition to the FOD benefit, this change could help to reduce employee exposure and decrease hazardous waste.

Chemical Inventory Optimization: The intern is researching purchasing strategies to reduce the occurrence of expired or unused chemicals. As part of these efforts the intern is identifying ways to ensure sufficient supplies for critical processes, yet enable reductions in inventory, purchasing, and disposal costs.

Segregate Solvent Wipes: The Resource Conservation and Recovery Act, (RCRA) creates the framework for proper management of hazardous and non-hazardous waste and assigns authority to the U.S. Environmental Protection Agency (EPA) to make rules and determinations regarding the RCRA framework. Under a rule set by EPA, the solvent-contaminated wipes may be excluded from hazardous waste regulation, provided that the company meets specified management requirements.

A program is in development to segregate RCRA-exempt disposable solvent-contaminated wipes from the hazardous waste stream. At Cobham, this project involves installing designated yellow bins that would collect only wipes that fall under the EPA exemption. As part of the roll-out of this procedural change, the intern will provide initial monitoring of the yellow bins to ensure conformity. Ongoing outreach and education materials are also being developed for employees to ensure proper segregation.



Paper Reduction: Cobham's Davenport facility has placed a high priority on reducing overall paper use. The intern has gathered data on paper use by departments across the company and identified paper-intensive processes. Using the data, the intern is developing source reduction solutions to reduce usage.

One source reduction strategy resulting from this project is the use of dual computer monitors for specific employees. This change has been implemented for various employees with high paper usage and resulted in a 50 percent decrease in paper usage in the first month where monitors were added. Creating online forms for specific internal repair orders is another reduction strategy being implemented. The intern helped established an electronic file storage system and created electronic forms for repair orders that previously had been submitted and kept in paper files. By initiating, handling, and storing all repair orders online, the company will save money and reduce unnecessary paper use. Similar opportunities with other hard copy forms will be sought out as feasible.

The intern is also exploring the possibility of installing computers in the employee training area. People going through training or recertification must have access to training documents to read through and use for studying. Previously, these documents were provided in hard copy form because some employees do not have computer access. Providing computers in the training area would allow employees to review training material, update documents electronically, and alleviate unnecessary printing.

NEXT STEPS:

During the second 12-weeks of the internship the intern will continue to work on hazardous waste reduction and paper reduction efforts. Efforts will include analyzing disposable waste streams, such as gloves and wipes, to determine where reusable supplies may be feasible and appropriate. The intern will also continue to investigate paper use in the site's high use processes and develop reduction strategies.

A final case summary for this project will be posted on the Pollution Prevention Intern Program website at www.iowap2interns.com in January 2020.

JBS SWIFT PORK

MOHAMMAD ELSOUHT
Major: Mechanical Engineering
Minor: Mathematics
The University of Iowa

COMPANY PROFILE

JBS USA is a leading global provider of diversified, high-quality food products. The company processes, prepares, packages and delivers fresh and value-added premium meat, poultry and retail-ready food products for customers in approximately 100 countries on six continents. JBS USA's exclusive global production and distribution platform covering five continents allows the company to service nearly every consumer market in the world, providing more than 270 million four ounce servings of protein to families every day. The company operates five pork processing facilities primarily located in the Midwest, one of which is JBS Swift Pork, a fresh pork and bacon processing facility in Ottumwa, Iowa. The plant in Ottumwa is one of the company's largest facilities and is witnessing continuous growth.

PROJECT BACKGROUND

The aim of this project is to reduce energy use of the compressed air system at the JBS Ottumwa plant. A comprehensive analysis of the compressed air system revealed inefficiencies in the system and presented opportunities to significantly reduce energy usage. Six projects with low initial investment and high return were recommended, presenting the plant with an opportunity to reduce the operational costs associated with compressed air generation and end-use applications. Current and future demand for compressed air at the facility were also assessed, and a preventative maintenance plan that includes air leak detection was studied.

INCENTIVES TO CHANGE

JBS has a 2020 sustainability goal of reducing electrical energy use by 12 percent and reducing greenhouse gases and emissions by 20 percent. Compressed air is a costly utility at the JBS Ottumwa plant, accounting for 9 percent of direct electrical costs. Compressed air also accounts for significant indirect costs contained within the water and HVAC systems at the plant. Additionally, there are many systems at the plant that are dependent on a consistent supply of compressed air, without which the plant suffers expensive downtime. Implementing projects that improve the efficiency of operating systems, such as compressed air, offers JBS valuable opportunities for cost reduction and meeting its environmental goals.

RESULTS

Rerouting Inlet Air Ducts: The compressors in the plant are currently configured to draw air from either inside the plant or inside the compressor room. Both hot and cool conditioned air drawn from inside the plant is very expensive to produce, depending on seasonal variations. During a week-long survey using temperature and humidity sensors, the air inside the compressor room was found to be at least 5°F hotter and significantly more humid than ambient air in other plant areas, which requires increased costs to cool and dry the compressed air. Drawing ambient air for compression was shown to be the most efficient option and would use significantly less energy. Quotes for this project have been provided and are awaiting approval and allocation of funds.

Adding Air Storage Capacity: The industrial standard for compressed air storage is 3-5 gallons per cfm, with two-thirds of that amount ideally in dry storage. At the Ottumwa plant, current available storage is approximately 2.86 gallons per cfm, the bulk of which is in wet storage. Having a higher storage capacity will ensure a smoother operation of the compressors, 5 percent power savings, and a measurable reduction in down time caused by an insufficient supply of compressed air. Adding dry storage would also mitigate the bottleneck restriction of the air flow rate by the dryer and filters during peak demand. Compressed air storage closer to the point of air use would also allow the operation of the equipment at a lower pressure, generating additional savings. Quotes for implementing additional dry storage have been provided and are awaiting management review and approval.

Using Effecient Air Nozzles for Drying: The current air wands used to dry the plant surfaces after sanitation clean-up are inefficient and create a peak air demand that is followed by expensive downtime. Installing a flat-end air nozzle with a flow control valve on these wands could reduce the air demand for clean-up by 75 percent, dropping from 367 cfm/wand to 93 cfm/wand. Samples of the recommended nozzles are available for onsite testing, after which a final management decision can be made.

Uninstalling Unnecessary Equipment: A chilled water-to-air shell & tube heat exchanger acts as a preliminary refrigerant cooler upstream of the vertical air receiver. After analyzing inlet air temperatures to the vertical air receiver, the cooling provided by this heat exchanger was found to be unnecessary. Uninstalling this heat exchanger could reduce annual water usage and associated cost savings.

Lowering the Supply Pressure: Implementing recommendations to improve dry storage and other system efficiencies will allow JBS to reduce the overall supply pressure of their compressed air system. Excessive pressurization leads to higher electrical costs, and magnifies the artificial demand presented by air leaks. Reducing the supply pressure by a recommended 10 PSI leads to a 5 percent reduction in compressor power, and cost savings.

Air Leak Detection and Repair: Air leaks are relatively easy to repair and present fast returns in savings with low initial investment. Using an ultrasonic leak detector, the intern detected and documented 130 cfm of pressure lost in air leaks. Purchase of an ultrasonic leak detector was also recommended, to support the inclusion of air leak detection in a quarterly preventative maintenance (PM) plan. Repair of the documented air leaks is underway, and an ongoing PM plan is in development.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Rerouting Inlet Air Ducts	$37,889	473,626 kWh	Recommended
Adding Air Storage Capacity	$177,801	421,638 kWh	Recommended
Using Effecient Air Nozzles for Drying	$70,642	651,191 kWh	Recommended
Uninstalling Unnecessary Equipment	$29,124	2,329,920 gallons	Implemented
Lowering the Supply Pressure	$33,731	421,643 kWh	In Progress
Air Leak Detection and Repair	$33,777	422,213 kWh	In Progress

JBS USA, LLC

ADAM FUERST
Majors: Chemical Engineering and Applied Mathematics
Iowa State University

COMPANY PROFILE

Headquartered in Greeley, Colorado, JBS USA is a food processing company and a subsidiary of JBS S.A., the world's largest meat processing company, by sales. The company mainly produces meat products and byproducts of beef, poultry, pork, and lamb, with more than 200,000 employees worldwide. The JBS facility in Marshalltown, Iowa, is a pork-based facility that employs more than 2,000 people and processes 20,000 hogs daily. JBS USA has a commitment to provide safe, sustainable products produced with a respect for our natural resources and the environment.

PROJECT BACKGROUND

Water conservation and reducing wastewater contaminant levels are top priorities and a constant focus of JBS' sustainability commitment. A state-of-the-art wastewater treatment facility was recently completed and is coupled with an onsite activated sludge plant (ASP), making JBS very effective at removing contaminants from the plant's wastewater effluent. This project was aimed at determining where and when various contaminants enter the wastewater streams and recommending ways to reduce contaminants in the effluent prior to onsite wastewater treatment. While evaluating the process flow, the intern was also able to recommend process improvements that could further reduce water usage.

INCENTIVES TO CHANGE

JBS USA has a commitment to provide safe, sustainable products produced with a respect for our natural resources and the environment. In line with this commitment, the company has a 2020 corporate environmental goal of 10 percent reduction in water usage from a 2015 baseline. The 2019 project will position the facility for the next steps to employ source reduction and pollution prevention methodologies in effectively reducing water usage, loading levels, and associated costs.

RESULTS

Increased Blood Capture: JBS considers it an obligation to maximize the use of every product they produce. Amino acids, tallows, and grease are all processed into marketable products. Blood meal is one of these valuable byproducts that is used in animal feed and fertilizers.

After the hogs are slaughtered and dehaired, they move through various initial processing stages. In these initial processing areas blood is collected in catch pans, which then funnel it to the drain and to wastewater. Pumping the collected blood back to the rendering area to be processed into dried blood meal could generate additional revenue and increase the value derived from each processed hog. Further, removing the blood from the wastewater process could reduce byproduct waste, decrease effluent contaminants, and decrease costs and treatment chemicals. Implementing this recommendation is relatively inexpensive, and next steps would include ordering and installing both the pump and piping required to reroute the blood to Rendering.

Tank Farm Grease and Lard Recycle: Grease and lard of various grades are also collected from the hogs. They are transported to storage tanks which are then emptied into shipping containers. Each day, a worker drains the excess water and solid material that settles in the bottom of the tanks. This residual is currently sent down the drain where the grease is recovered from the wastewater for processing. Pumping the residual from the storage tanks directly back to the rendering area would allow a purer form of the grease to be recovered and processed, providing a higher grade grease from this source point. In addition to the added revenue potential, the wastewater load and associated costs would be reduced. Much of the piping from the storage tanks to Rendering is in place so there would be minimal cost to implement this change. A quote has been obtained to complete the piping, so installation could be started, pending approval.

Air Cooled Condenser: A Rendering cooker takes inedible solids from production and converts them into various marketable products. The moisture is evaporated from the inedible solids in the cooker, then taken to two heat exchangers where it is condensed back into a liquid. These heat exchangers are water cooled and generate a significant amount of hot (140°F) water as a byproduct. The hot water is used throughout the plant for sanitation, but not all of the water can be used and eventually exceeds the capacity of the storage tanks. The excess hot water is sent to wastewater and is treated with the process water coming from the other areas of the plant. Switching the two water-cooled heat exchangers to an air-cooled condenser would eliminate the water associated to cool the heat exchangers, which could also eliminate the excess flows and associated treatment costs in wastewater. This could result in a significant reduction of 140°F water generated at the plant. A quote for the air-cooled condenser has been obtained. This project would require capital investment so project approval and budgeted funds would be required for implementation.

Wastewater Solids Collection: In the wastewater facility, solids from production wastewater effluent are collected by rotor screens and subsequently pumped to Rendering to be

processed. Water must be added to allow the solids to be successfully pumped, and the added water is then screened back out in the rendering area. The Rendering system was not designed with the capacity to screen the high volume of excess flow generated by this process. When its capacity is exceeded, the excess water and solids overflow into the drain and get pumped back to wastewater, which creates a costly cycle. Using an incline auger to collect these solids in bins at the wastewater facility, and physically transporting those bins to the rendering area, would eliminate the additional water for the solids to be pumped. It could also alleviate the overflow in the rendering area and water required to pump the material, and could eliminate the excess maintenance and cleanup costs incurred when the wastewater system becomes overloaded. To implement this recommendation, the next steps would be to obtain budget approvals, review the quote obtained for the incline auger and order equipment and plan the installation process.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Increased Blood Capture	$199,099	17,430 lbs TKN 5,817 lbs TSS	Recommended
Tank Farm Grease and Lard Recycle	$15,446	9,972 gallons grease 3,324 gallons lard	Recommended
Air Cooled Condenser	$794,670	127,000,000 gallons	Recommended
Wastewater Solids Collection	$123,488	15,581,250 gallons	Recommended

ROSENBOOM

DAYTON WRIGHT

Major: Chemical Engineering
Iowa State University

COMPANY PROFILE

Rosenboom is a family-owned business started in 1974 by Lary and Viv Rosenboom. They have become the leading manufacturer of custom crafted hydraulic cylinders for consumers large and small. Their corporate headquarters is located in Sheldon, Iowa, with manufacturing plants in Sheldon and Spirit Lake, Iowa, and Bowling Green, Ohio. Rosenboom currently employs 934 people who are all focused on delivering a quality product at a competitive price. The company is dedicated to sustained growth through continuous improvement, exceeding customer quality and service requirements, and minimizing environmental impact.

PROJECT BACKGROUND

In Rosenboom's efforts to limit their environmental impact, hazardous waste reduction was a top priority for Rosenboom's 2019 intern project. Two primary areas of focus were the metal finishing area and the paint line, the plant's two largest hazardous waste producers. The metal finishing area utilizes chrome plating machines which generate hazardous waste in the form of chrome contaminated debris and mop water. The paint line produces waste in the form of washer sludge, paint booth paper, and solvent still bottoms. It was the intern's goal to limit hazardous waste in both of these areas.

INCENTIVES TO CHANGE

Rosenboom's commitment to continuous improvement includes an unfailing focus on minimizing their environmental footprint. Currently, Rosenboom is a large quantity generator (LQG) of hazardous waste, producing more than 1,000 kilograms of hazardous waste per month. Efforts to reduce hazardous waste generation onsite will support their goal of continuous improvement and reduce Rosenboom's environmental impacts, moving them closer to a goal of achieving small quantity generator (SQG) status. Additional benefits would include the health and safety benefits of reduced hazardous materials onsite, and reduced costs associated with management and disposal of the hazardous materials.

RESULTS

Mop Water Reuse: When the metal finishing area was built, Rosenboom saw an opportunity to recycle rinse water from the end of the chrome plating machine using a designated water treatment system. The specialized system would be able to filter the chrome from the rinse water and reuse the filtered water in the tanks for the chrome plating machines to make up for evaporative losses, provided a set purity standard for the water could be attained. Working with the system vendor, a system was customized that could provide an opportunity for water reuse and reduce hazardous waste generation of the chrome mop water. This project is awaiting management review and approval.

Washer Automation: The current multistage washer used by the paint line runs continuously while the plant is in operation, even when parts are not being run through the washer. Energy is lost when the pumps operate needlessly, and increased evaporative losses occur. Water losses also occur when the washer's makeup water stream runs during these downtimes. Motion controlled or on-demand flow control switches that detect when a part carrier was about to enter the washing unit could offer significant water and energy savings in the washer process. There is some automation infrastructure in place to support this recommendation. A photo-eye sensor or a whisker switch could be wired to the existing automation processor with timers and counters so that each stage would smoothly and systematically turn on and off as needed. This project has been approved and added to the company's implementation schedule.

Paint Process Consistency: The intern spent a considerable amount of time observing the paint line processes, noting parts, colors and color changes, and painting techniques. It was noted that, while skilled, the painters use varying techniques and styles in terms of stroke length, direction, and duration on the same parts. Adopting a unified painting method that incorporates best management practices has been proven to increase transfer efficiency in industrial paint applications. Customized programs are available that include classroom instruction, virtual painting training, and in-booth training and observation. Case studies from the recommended training program have shown it to increase paint transfer efficiency by an average of 30 percent and reduce paint time by 3 percent. These efficiency gains lead to less paint waste, reduced hazardous waste generation and increased production efficiency. This project is under consideration and awaiting management review and approval.

Solvent Recycling: Still bottoms from the solvents used on the paint line account for most of the hazardous waste generated in that department. Used solvent is collected into a 55-gallon drum and the solids are settled to the bottom. The liquid solvent is recycled onsite, which results in recovered solvent that can be reused and additional solids that must be disposed of as hazardous waste. Using an offsite recycling vendor would allow used solvent to be recovered in a larger, more efficient system, leading to increased solvent recovery. The used solvent could be collected from both the Sheldon and Spirit Lake production facilities for the recycling and recovery process. Reclaimed solvent could be returned to both plants for further use. A sample of the solvents needs to be analyzed to determine economic feasibility. This sample analysis is in progress, and upon completion, results can be reviewed and next steps determined.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Mop Water Reuse	$2,738	8.5 tons of mop water	Recommended
Washer Automation	$9,643	35,583 kWh 1,022,254 gallons 16,988 therms	In Progress
Paint Process Consistency	$853	1 ton paint booth paper	Recommended
Solvent Recycling	TBD	TBD	Further Analysis Needed

SMITHFIELD FOODS, INC. - DENISON

MICHAEL LAKE
Major: Chemical Engineering
Minor: Chemistry
The University of Iowa

COMPANY PROFILE

Smithfield Foods, Inc. is a global food company and considered the world's largest pork processor and hog producer. Smithfield Foods originated as Smithfield Packing Company in 1936 in Smithfield, Virginia, where the corporate headquarters are still located today. Smithfield employs more than 54,000 people companywide and generates $15 billion in sales. The Smithfield Foods location in Denison, Iowa, employs more than 1,600 people and produces three main products - ready-to-eat hams, ready-to-cook bacon, and fresh pork.

PROJECT BACKGROUND

The purpose of this project was to assess water usage on Smithfield's harvest floor. Pork processing is a very water intensive industry. Approximately two-thirds of all water used at the Denison facility is used on the harvest floor. The goal of this project was to find ways to reduce or reuse process water in this heavy-use area. Of particular focus for this project were the dehair and evisceration processes. Both areas are among the biggest water users on the harvest floor.

INCENTIVES TO CHANGE

The Denison facility has two water reduction goals. The first goal is a facility-level target to reduce water usage by 2 percent in 2019. Meeting this target will help position the facility to meet a corporate goal of reducing normalized water usage at all Smithfield facilities 10 percent by 2020 from a 2014 baseline. Normalized water usage is defined at Smithfield as gallons of water used per 100 pounds of product. The 2019 intern's work is considered a key contributor to the facility's efforts in meeting these sustainability goals.

RESULTS

Dehair Makeup Water Recycle: The dehair machine uses more water than any other piece of equipment on the harvest floor. Most of the water used for the dehair process is retained and recycled via makeup tanks back to the dehair machine throughout the production day. However, some of the water is lost due to the vigorous vibrations the machine experiences during operation. This lost water flows into a trough before going through a rotary screen and is then sent to wastewater. Recapturing and reusing this lost water back within the dehair machine would create a closed water loop for the system and present numerous benefits.

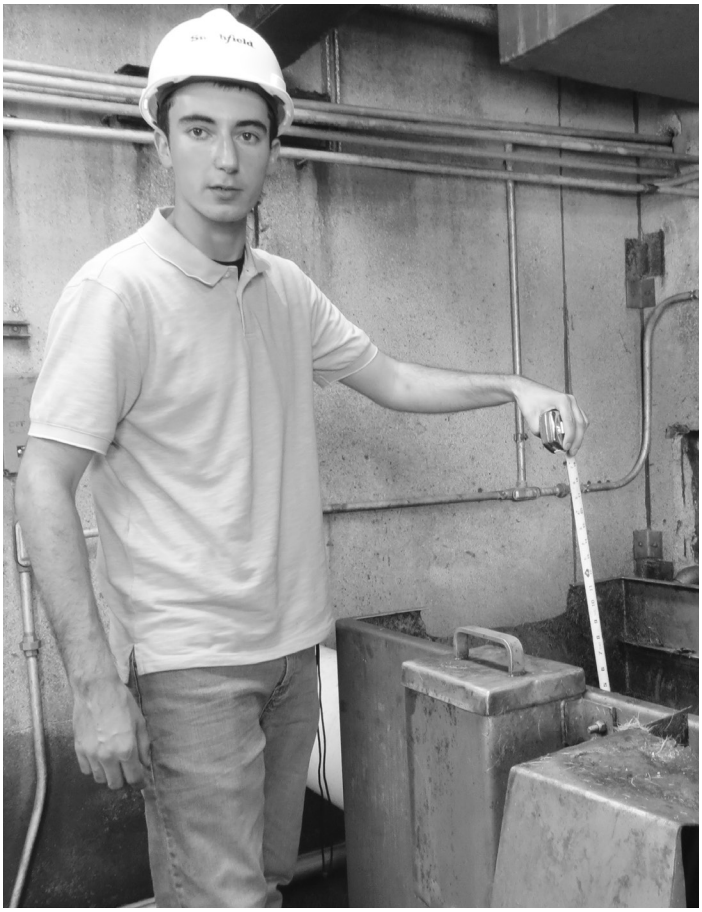
Closing this water loop would reduce water use by eliminating the need to introduce fresh makeup water to the dehair system. Because the dehair water is heated, reusing the existing water would also reduce the amount of energy needed to keep the water supply at the target temperature. Additionally, the rotary screen would no longer be needed for this process and could be eliminated.

To achieve this recommendation, a sump pump would need to be installed in the initial collection trough to pump the lost dehair water back into the makeup tanks. Plans have been made to set up this water recycle loop. After implementation, testing will be done to ensure the optimum makeup water level in the tank is maintained.

Tray Wash Water Reduction: The tray line is another large water user on the harvest floor. The tray line operates as a conveyor system used to transport eviscerated organs to other production areas. The trays must be washed and sanitized after each pass on the conveyor system so that new evisceration material can be placed on a clean surface and eliminate any risk of cross contamination. The conveyor also uses water to lubricate the rollers and keep the conveyor running properly.

Tests were performed varying the amount of wash water used to clean the trays. Using an ultrasonic flow meter to measure the various flow rates, it was found that the flow of water could be reduced while still maintaining stringent sanitation standards. Once the optimal amount of water flow was determined, an in-line flow meter was installed on the water feed to the wash station. This flow meter has a built in control that will restrict water flow to the specified flow rate and reduce excess water use in this area. The only remaining component of implementation is writing a standard operating procedure and training on-site personnel on the operation of the flow meter.

Shaving Line Water Reuse: The shaving line utilizes water to lubricate the surface of the hog before employees manually shave off any hair remaining after the hog has gone through the mechanical dehair processes. Fresh water was being supplied to the spray bar utilized on this line. The outlet for cooling water used in the nearby singers is located in close proximity to the water source for the shaving. The singer cooling water is non-contact water that represents a great reuse opportunity. Piping has been added to use the singer cooling water to supply the shaving line spray bar. The original valve feeding this process was kept in place and it simply turns on water from a different source to supply water to the spray bar. The costs to implement this project were minimal due to the proximity of the singer water outlet to the shaving line and no changes were needed to employee procedures at the shaving line.



PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Dehair Makeup Water Recycle	$32,710	4,161,600 gallons	Recommended
Tray Wash Water Reduction	$39,252	4,993,920 gallons	Implemented
Shaving Line Water Reuse	$4,252	541,008 gallons	Implemented

SMITHFIELD FOODS, INC. - SIOUX CITY

ZACHARY KAZMER
Major: Chemical Engineering
Minors: Chemistry and Psychology
The University of Iowa

COMPANY PROFILE

Smithfield Foods, Inc. is the world's largest pork processor and hog producer. The company is committed to providing good food in a responsible way and maintains robust animal care, community involvement, employee safety, environmental, and food safety and quality programs. In the United States, the company is also the leader in numerous packaged meats categories with popular brands including Smithfield®, Eckrich®, Nathan's Famous®, Farmland®, Armour®, Farmer John®, Kretschmar®, John Morrell®, Cook's®, Gwaltney®, Carando®, Margherita®, Curly's®, Healthy Ones®, Morliny®, Krakus®, and Berlinki®. The company's facility in Sioux City, Iowa, produces packaged meats, specializing in barbeque meats and pork ribs. With more than 600 employees, Sioux City's facility is capable of processing more than 100 million pounds of meat.

PROJECT BACKGROUND

Smithfield's Sioux City facility is continually pursuing projects that increase sustainability and improve environmental performance. Cooling water is required for several types of machines throughout the facility. Incorporation of a cooling system would provide opportunities for much of this water to be reused throughout the process before being discharged. Excess water use in cooking and sanitation processes could be reduced by automating systems and modifying procedures.

INCENTIVES TO CHANGE

Smithfield has many sustainability goals and targets aligned with reducing its environmental impact, earning ISO 14001 certifications in all applicable facilities in 2005. By 2020, it is expected that all farms and facilities will reduce water usage by 10 percent and energy by 5 percent from a 2014 baseline. The Sioux City facility strives to exceed these goals. As part of the company's commitment to responsible operations, two previous Pollution Prevention interns completed projects in compressed air system efficiency and solid waste reduction. This summer's project to reduce water usage throughout the facility will align the Sioux City facility with the company's sustainability targets while reducing operating costs.

RESULTS

Spray Injector Closed-Loop Cooling: Two spray injector machines are used on the preparation side of the facility to inject brine evenly into a variety of meats, such as pork shoulder, chicken breast, and chuck roast. Cooling water is used to remove heat from the machine's oil and keep it running in optimal condition. A single-pass cooling system is used with a valve controlling the cooling water based on oil temperature. The control valves in both injectors were not operating properly resulting in a continuous flow of cooling water. Replacing the single-pass system with a closed-loop cooling system could generate significant water savings. A closed-loop system would pump heated water through a cooler and then recycle it to the cooling water inlet. Holding tanks would be used prior to the heated discharge streams entering the coolers. Similar closed-loop systems are currently used for other processes at the facility and could be easily replicated for use with the spray injectors. The equipment for the closed-loop system is scheduled to be purchased and installed once the plant completes its changeover to closed-loop systems for other specified processes.

Conveyer Belt Sanitation Timer: Clean-in-place (CIP) systems are installed on the ends of two conveyer belts in the rib room, which allows for sanitation of the belts without constant employee supervision. Workers connect the hose to the CIP system, which sprays water through gaps in the continuously moving belt and sanitizes the belt surface. Once the hose is connected, workers may move on to another task while the system runs. Current requirements dictate the CIP run for two minutes, allowing for three full passes of the belt, which has proven effective for cleaning and sanitizing the belts. However, with this process being controlled manually, it often runs continuously and longer than necessary, until someone is free to shut it off.

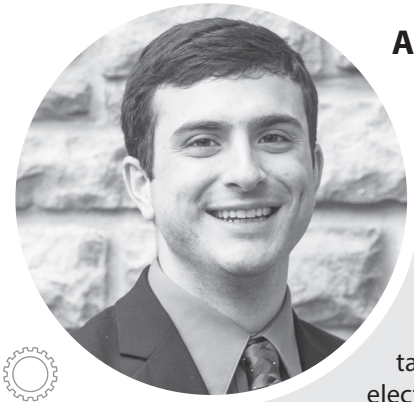
Installing a solenoid valve and timer to automatically close the hot water pipe after two minutes would effectively manage the run times of the CIP systems and alleviate the need for manual operation of the process. In addition to significant reductions in water usage, automating this process could enable the sanitation employees to perform other tasks uninterrupted while the CIP is running. To implement this recommendation, a timer and solenoid valve will need to be ordered and installed on the hot water pipe.

Serpentine Oven Cold Water Automated Filling: Serpentine ovens have continuous moving trays that hold meat during cooking. The trays move horizontally along the bottom of the oven and then vertically move in a serpentine motion through the rest of the oven. Hot water is used to blanket the bottom of the oven to collect and drain grease and meat scraps that fall off the product during the cooking process. Since the water takes more than 15 minutes to fill, employees load the ovens with meat before terminating the fill which leads to overfilling, especially in less-trafficked areas of the cookhouse.

A switch and solenoid system could be installed on the water tanks to prevent overfilling. By switching pipe-header connections and installing probes with solenoid valves on the current water pipes, significant water and energy savings could be realized. It was also determined that hot water is not required for this particular process. Switching to cold water for filling the ovens could reduce natural gas used for heating this water. To implement this recommendation, each Serpentine oven would need to have a solenoid system installed on the source pipe, and water tanks would each need an electronic probe installed at the fill line. The piping connections could be switched during a scheduled shutdown of the cookhouse.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Spray Injector Closed-Loop Cooling	$10,855	1,955,893 gallons	Recommended
Conveyer Belt Sanitation Timer	$3,049	337,886 gallons 3,170 therms	Recommended
Serpentine Oven Cold Water Automated Filling	$15,534	1,359,971 gallons 21,580 therms	Recommended

STANLEY ENGINEERED FASTENING



ANTHONY KLUCH
Major: Chemical Engineering
Minor: Chemistry
The University of Iowa

COMPANY PROFILE

Stanley Engineered Fastening, a division of Stanley Black and Decker, produces fasteners and assembly solutions. The facility in Decorah, Iowa, currently employs 379 workers who are dedicated to producing quality products. Part production focuses mainly on large-scale tapped extrusions with a variety of metals and alloys. In-house processes include passivation, electroplating, CNC, and heat treatment. Stanley is a global provider of fastening solutions for major projects and products, with an annual production of 1.3 billion fasteners.

PROJECT BACKGROUND

At the Stanley Decorah facility, nitric acid is used for stripping copper coating from parts, and for the passivation of stainless-steel fasteners. Stanley Engineered Fastening asked their Pollution Prevention Intern to find a suitable chemical to replace the nitric acid used for passivation. Additional projects centered on optimizing the cleaning, stripping, and passivation lines, including finding a more cost-effective substitute for alkaline cleaners and rinsing agents. Piping and instrumentation diagrams (P&IDs) of all the systems analyzed in this project were developed to aid in future maintenance and update work. While onsite, the intern also developed a preliminary analysis of the feasibility of implementing wind energy.

INCENTIVES TO CHANGE

The passivation, cleaning, and stripping line used at the Stanley facility uses a scrubber system to control the fumes generated from the nitric acid passivation tank. A less hazardous alternative chemical would reduce the overall quantity of hazardous materials used onsite, eliminate the use of extensive personal protection equipment (PPE) for refilling and emptying of these tanks, and improve the working environment for line employees.

Corporate goals for Stanley Black and Decker include reducing carbon emissions by 20 percent and to have 10 percent of their overall energy use produced from renewables by the end of 2019. Stanley Decorah has a potentially favorable location on part of their property for installation of a wind turbine and there is considerable interest to look into the viability of wind energy at the plant. These goals presented an opportunity for the Stanley Decorah plant to investigate the feasibility of wind energy.

RESULTS

Replacement of Nitric Acid with Ambidet PS96: Stanley currently uses nitric acid for stripping copper from parts and for the passivation of stainless-steel. Scrubbers, extra PPE, and line downtime are required for the operation and refilling of the nitric acid tanks. Two potential alternatives were evaluated using small-scale lab testing. One of these alternatives, Ambidet PS96, produced favorable results both in cleaning and passivating the parts. While the PS96 is more expensive to purchase than nitric acid, the benefits of eliminating the use of nitric acid in this process would outweigh the additional cost. Parts that require passivation must meet additional criteria and specifications dictated by the end use customer, and must be approved by the customer(s), prior to any changes made to the production processes. This recommendation will require additional review and approval before implementation may be considered.

Alkaline Cleaner Substitution: Large quantities of alkaline cleaners are used on the passivation, stripping, and cleaning line at Stanley. With such large quantities of cleaner being used, an analysis was conducted to determine if there was a viable alternative that could be effective in smaller quantities and/or at a lower cost. Large scale testing was completed and while the results didn't allow for an option to be used in lesser quantities, it did identify an alternative cleaner, Power Soak LS-150 that was effective in Stanley's cleaning applications and could be used in the same quantities but for a lower cost. The switch to the new cleaner has been completed and it is currently being used on the production line.

Electrocleaning Cleaner Substitution: Stanley uses two types of processes for the cleaning of their fasteners. When alloy parts are sent through the line they are cleaned by an electrocleaning process. This process requires a conductive cleaner that is significantly more expensive than the traditional alkaline cleaner, Power Soak LS-150, being used in the other cleaning process line. The intern recognized that the Power Soak product has a manufacturer specification for electrocleaning. As a result, large-scale comparison testing was conducted to determine the viability of using the Power Soak in Stanley's electrocleaning process. It was determined that at a 10 percent concentration, the Power Soak is effective and cleans comparably to the current conductive cleaner. Being able to use the same cleaner for both cleaning lines will decrease the number of different chemicals on the factory floor and simplify the overall cleaning process for their fasteners. Because the Power Soak is already available onsite, its use in the electrocleaning process can be implemented once formal approval for a permanent switch is granted.

Finishing Rinse Agent Substitution: Stanley uses a finishing rinse agent at the end of the passivation line to help with the final physical appearance of parts. A generic version of this rinse product is available and two large-scale tests determined that the generic product performed as well or better than the current rinse agent and was more cost effective. The replacement product is readily available for use with approval.

Wind Turbine Feasibility Study: Stanley Black and Decker has a corporate goal of receiving 10 percent of its energy, across all facilities, from renewable sources. A site-specific initial feasibility analysis was completed by the intern and modeled after a wind turbine that was recently constructed at Luther College in Decorah. With the project costs modeled after the Luther wind turbine and using wind data from 2011 and 2012, it was determined that there is potential for a wind turbine to supplement the energy use at the Decorah plant and generate significant cost savings. A multi-phase study is recommended to more accurately determine power output, life cycle costs, and cost saving potential.

Piping and Instrumentation Diagrams: The intern developed P&IDs for the electroplating line and the passivation, cleaning, and stripping line. Accurate P&ID files reduce downtime for maintenance by allowing for quick location of valves and pipes. Files were created in the same format as previous company P&IDs to maintain consistency and ease of use.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Replacement of Nitric Acid with Ambidet PS96	$101	1,367 gallons Nitric Acid Risk Avoidance	Recommended
Alkaline Cleaner Substitution	$14,559	N/A	Implemented
Electrocleaning Cleaner Substitution	$6,580	N/A	Recommended
Finishing Rinse Agent Substitution	$3,148	121 gallons water	Recommended
Wind Turbine Feasibility Study	$400,233	5,771,391 kWh	Recommended
Piping and Instrumentation Diagrams	$750 (one time)	N/A	Implemented

TYSON FOODS INC. HILLSHIRE BRANDS

AUSTIN DOAK
Major: Chemical Engineering
Minor: Mathematics
The University of Iowa

COMPANY PROFILE

Originally established in 1935, Tyson Foods Inc. is a multi-national protein-focused food company that employs 122,000 employees in more than 300 facilities worldwide. Within Tyson's Prepared Foods division is Tyson Hillshire Brands, a turkey processing facility located in Storm Lake, Iowa. The Storm Lake operations include processing of live turkeys and fabrication of carcasses into bulk quantities of white and dark meat cuts, along with pre-blended sausage mixtures. The facility operates two eight-hour production shifts and one sanitation shift five days a week. More than 700 team members work at the Storm Lake facility with the resources to process 36,000 turkeys daily.

PROJECT BACKGROUND

At Tyson Storm Lake, water is used in nearly every stage of poultry processing for scalding, defeathering, carcass washing, carcass chilling, offal removal, product movement, and sanitation. The focus of this project was to explore water reuse opportunities from process and wastewater pretreatment areas of the plant, and evaluate pollution prevention methodologies that will reduce overall water consumption. Traditional water conservation practices, including spray nozzle size reductions in the evisceration department, were also investigated.

INCENTIVES TO CHANGE

Tyson Foods Inc. strives to follow sustainable practices to align with their commitment to "Reduce our environmental impact as we feed the world." In reflection of this commitment, Tyson has set a corporate goal to reduce their water use intensity 12 percent by 2020 compared to 2015 baselines. To assist in meeting this corporate goal, the Storm Lake location has set a facility goal to reduce annual water consumption 4 percent during fiscal year 2019. Reducing water consumption decreases chemical use and wastewater processing required and saves on the energy required for heating, cooling, and pumping water.

RESULTS

Evisceration Wash Cabinet Reuse System: During evisceration, various wash cabinets are used to rinse turkey carcasses. Currently, all these washes utilize potable water, though water conditioned to this level is not required. An industrial water reuse system for this process area would greatly reduce overall water consumption. Such a system would collect process water from the largest wash cabinet at the end of the evisceration process, recondition the water with a series of filters and antimicrobial chemistry, and then supply the reconditioned water to three upstream wash processes. An analysis of the potential economic and environmental savings associated with three vendor proposals submitted to Tyson to complete this project has been conducted. Additionally, water sampling out of the large wash cabinet has been completed to determine baseline water quality. To implement, a specific proposal must be selected and funding will need to be approved.

Evisceration Spraying System Modifications: Using an ultrasonic transit time flow meter, the intern quantified water flow rates at different pieces of equipment to identify opportunities in the evisceration process to reduce water usage. Alternative spraying systems for three wash processes were investigated to reduce overall water consumption and maintain an effective level of cleaning. New nozzles purchased for one wash cabinet alone will reduce overall capacity by 12 gallons per minute while maintaining the same spray coverage, resulting in an annual reduction of nearly 3 million gallons of water. Since the water at this wash is heated, it will also reduce natural gas usage by 6,180 therms. In the two other washes the use of new low-flow showerheads and a restrictor orifice plate will save an additional 259,000 gallons annually. Nozzles and showerheads have been purchased but must undergo testing with the Food Safety and Quality Assurance (FSQA) department prior to implementation.

Wastewater Effluent Truck Wash System: In the live receiving and offal departments, water is used to wash trucks after birds are unloaded, for general sanitation purposes, and in three rotary screens used to prevent large solids from entering the wastewater system. Pretreated effluent from the facility's wastewater pretreatment plant could be used in the truck wash system in place of fresh potable water. To be used for the truck wash system, effluent must be heated to 140°F at 500 psi. Reuse of pretreated wastewater effluent could reduce overall water consumption but would require additional natural gas for heating.

A multi-boiler and heat exchanger system to heat and pressurize the effluent was quoted but is not currently feasible. Additional calculations determined that with the addition of a 5,000-gallon hot water storage tank, the facility's current boiler system could accommodate the heating load required. The wastewater effluent was also tested to determine additional filtration and chemical treatment needs. To advance this project, further analysis of equipment and water treatment needs and costs should be completed.

Chiller Water Reuse: At the Storm Lake facility, four large immersion chillers containing water mixed with an antimicrobial agent are used to decrease the temperature of poultry products after the evisceration process. Chilling is an essential step in primary processing because it extends the shelf life of fresh meat and poultry by preventing or slowing down microbial growth. The smallest of these chillers has a volume of 33,060 gallons and is refilled daily, whereas the other three are filled only once a week. It is recommended that the smallest chiller's water also be held for a week at a time, which will greatly reduce fresh water usage. A thorough microbiological analysis of the chiller water will be required prior to implementation to confirm safe holding limits for the chiller water.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Evisceration Wash Cabinet Reuse System	$228,379	25,920,000 gallons 21,392 therms	Recommended
Evisceration Spraying System Modifications	$30,194	3,223,200 gallons 6,180 therms	In Progress
Wastewater Effluent Truck Wash System	$48,556	17,940,000 gallons	Further Analysis Needed
Chiller Water Reuse	$55,475	6,612,000 gallons	Recommended

TYSON FRESH MEATS, INC.

CHRIS BERG
Major: Mechanical Engineering
Minor: Spanish
Iowa State University

COMPANY PROFILE

Tyson Fresh Meats Inc. is a multi-national corporation founded in 1935 that produces value-added foods, prepared foods, and commodity meats at its 123 processing plants. Farmers from 18 states are contracted to supply livestock to the processing plants throughout the country. The company has grown to be the world's second largest processor of chicken, beef, and pork with more than 122,000 employees. The Tyson Fresh Meats facility located in Storm Lake, Iowa, is one of Tyson's six pork processing plants, has more than 2,200 employees, and processes more than 17,000 hogs daily.

PROJECT BACKGROUND

Pork processing is a very water intensive process. Water is used in most every stage of pork production including: harvesting, process applications, heating and cooling, steam generation, and sanitation. In 2017, Tyson Storm Lake partnered with the Pollution Prevention (P2) Intern Program to reduce water use in the process areas of the plant. Building on the successes of that project, Tyson Storm Lake again requested an intern with the P2 program to reduce water usage in the mechanical systems and targeted process areas of the plant. This year's project identified opportunities in the boiler and steam system and on the harvest floor.

INCENTIVES TO CHANGE

Since 2006, Tyson has created an annual sustainability report with a focus on animal welfare, food, community, the workplace, and the environment. One of Tyson's environmental goals is to achieve a 12 percent reduction in water used per pound of product by 2020 from a 2015 baseline. As of 2018, water usage per pound of product has been reduced approximately 3 percent from the 2015 baseline. This year's P2 Intern project will help further reduce water and natural gas usage at the Storm Lake plant contributing to the company-wide sustainability goals.

RESULTS

Boiler Flash Tank Economizer: Boiler blowdown occurs when the level of solids in the boiler water reaches a certain threshold. Removing this water keeps the boilers operating efficiently. Due to the high temperature of the blowdown water it cannot be sent directly to the drain. Instead, it is sent to a flash tank that converts the blowdown water into steam using a sudden pressure drop. Because of the solids present in the blowdown water, the resulting steam could not be used in the plant processes and is being vented to the atmosphere. Reusing this steam could lower the demand on the boilers and reduce the overall water and natural gas costs. Replacing the current flash tank with a flash tank economizer would allow this steam to be used by the deaerator to remove oxygen from the feedwater. A flash tank economizer uses centrifugal motion in an entrainment baffle to separate blowdown water from steam. Steam from the boilers that had been supplying the deaerator could instead be sent to processes throughout the plant. To implement this project, funding would need to be approved, equipment purchased, and piping from the flash tank economizer to the deaerator would need to be installed.

Steam Trap Repair: When steam utilizes its energy to heat product, it eventually condenses back into a hot liquid called condensate. Steam traps ensure that steam systems are operating as efficiently as possible by removing condensate from equipment and returning it to the boilers to be turned back into steam. Over time, traps become inefficient (failed), which can lead to energy loss, water loss, and damage to piping and equipment in the steam system from water hammer. Using an ultrasonic leak detector and a non-contact thermometer, the intern conducted an analysis of the steam system. Nearly 40 percent of the steam traps were found to have failed and 44 percent of the traps were leaking. Repairing the steam traps could increase the amount of condensate return from the traps by 20 percent and lower the high demand of steam production on the boilers. It would also improve the speed and efficiency of equipment throughout the plant, and reduce both water and natural gas usage and associated costs. Next steps for achieving efficiency of the steam system are to repair leaks, and repair or replace steam traps as needed.

Steam Trap Preventative Maintenance: A preventative maintenance program (PM) implemented by maintenance staff would help to maintain the efficiency of the steam system and reduce equipment damage. According to a U.S. Department of Energy publication series on energy efficiency, approximately 20 percent of steam can be lost to leaking traps in a typical distribution system that does not have a preventative maintenance program. Having a regularly scheduled PM program would ensure that future failures are identified and repaired in a timely manner, leading to ongoing water and energy savings. An ultrasonic leak detector is an effective tool for both steam and compressed air system preventative maintenance. Standard operating procedures and a cost calculator for failed or leaking steam traps have been prepared by the intern and made available to the maintenance staff. Acquisition and training provided to maintenance staff on use of the leak detector would be the next steps to implement a PM program.

Harvest Floor Water Reduction: The ambient temperature of the harvest floor is very hot due to several pieces of nearby equipment emitting heat into the room. The heat from the equipment also heats the pipes that supply water to the drinking fountains on the harvest floor. In order to keep the temperature of the drinking water cool, the valves on the drinking fountains are left open throughout production so cool water is readily available. The drinking water is not used consistently during a production shift. It was observed that at all other times, the water is going directly to the drain and, eventually, the wastewater treatment plant. When testing the water fountain's current state, the time delay to get cool water from a non-continuous running fountain was found to be less than five seconds. It is recommended that water fountain heads with automatically closing valves be installed on the harvest floor water fountains. Installing these new water fountain heads would reduce water usage by more than 1.3 million gallons annually. To implement this project, funding for the fountain heads will need to be approved and maintenance staff will need to install the new fountain heads.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
Boiler Flash Tank Economizer	$20,818	823,062 gallons 84,994 therms	Recommended
Steam Trap Repair	$55,845	4,984,080 gallons 123,851 therms	Recommended
Steam Trap Preventative Maintenance	$27,922	2,492,040 gallons 61,926 therms	Recommended
Harvest Floor Water Reduction	$6,222	1,390,829 gallons	Recommended

2019 PROJECT INDEX

POLLUTION PREVENTION INTERN PROGRAM

ALTERNATIVE ENERGY

- Stanley Engineered Fastening

BOILERS/STEAM

- Cambrex
- Tyson Fresh Meats, Inc.

CHEMICAL SUBSTITUTION/REDUCTION

- Cambrex
- Cobham
- JBS USA, LLC
- Stanley Engineered Fastening

COMPRESSED AIR

- JBS Swift Pork

COOLING TOWERS/CHILLERS

- Cambrex

ENERGY REDUCTION

- Cambrex
- CNH Industrial America, LLC
- JBS Swift Pork
- Rosenboom
- Smithfield Foods, Inc. - Sioux City
- Tyson Foods Inc. Hillshire Brands
- Tyson Fresh Meats, Inc.

HAZARDOUS WASTE

- Cobham
- Rosenboom

HVAC

- CNH Industrial America, LLC

LIGHTING

- CNH Industrial America, LLC

PROCESS IMPROVEMENT

- Cambrex
- Cobham
- JBS Swift Pork
- JBS USA, LLC
- Rosenboom
- Smithfield Foods, Inc. - Denison
- Smithfield Foods, Inc. - Sioux City
- Stanley Engineered Fastening
- Tyson Foods Inc. Hillshire Brands
- Tyson Fresh Meats, Inc.

SOLID WASTE MANAGEMENT

- Cobham
- JBS USA, LLC
- Rosenboom

WASTEWATER

- JBS USA, LLC
- Smithfield Foods, Inc. - Denison
- Tyson Foods Inc. Hillshire Brands

WATER USE REDUCTION

- Cambrex
- JBS Swift Pork
- JBS USA, LLC
- Rosenboom
- Smithfield Foods, Inc. - Denison
- Smithfield Foods, Inc. - Sioux City
- Tyson Foods Inc. Hillshire Brands
- Tyson Fresh Meats, Inc.

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POLLUTION PREVENTION

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