Heartland Corn Products

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Organization Background

Heartland Corn Products (HCP), an agriculture cooperative established in 1992, produces ethanol, corn oil and dried-distillers grain (DDGS). As a cooperative, farmers deliver corn proportional to shares in the company and benefit from the value of the products less the costs of operations. HCP currently has about 60 employees and produces over 140 million gallons of ethanol, 6 million gallons of corn oil, and 290,000 tons of DDGS each year.

"In two weeks, I progressed from an undergraduate student overwhelmed by the magnitude of an ethanol plant to an intern eager to solve water conservation problems. This internship expanded my understanding of concepts covered in my chemical engineering courses and allowed me to take control of my project while working alongside experienced professionals." ~ DI

Project Background

Industrial cooling at HCP uses around 214 million gallons of water and discharges around 37 million gallons of water each year. HCP had already mapped water usage and process flow in the plant and identified the cooling towers as a focus for the project. Cooling towers continuously cycle water and as some of the water evaporates the conductivity of the water reaches a set limit and the water is released as blowdown. Adjusting the number of cycles the water does in the cooling towers (cycles of concentration) will provide opportunities to optimize cooling tower water efficiency and reduce wastewater discharge. This project also identified energy conservation opportunities such as stack heat recovery and cold-adaptive enzymes for starch hydrolysis.

Incentives To Change

As HCP plans to increase ethanol production, wastewater discharge to the city has become one of the factors preventing expansion. HCP has a wastewater limit of 100,000 GPD which it currently struggles to meet. Investment in water and energy conservation will reduce the consumption of water, decrease effluent discharge, and realize cost savings.

SOLUTIONS

Increase to 9 Cycles of Concentration

Expanding ethanol production would put more pressure on the cooling towers, thereby increasing cooling tower water consumption and blowdown (wastewater discharge) to the city. The recommendation is to increase to 9 cycles of concentration by raising the ratio of low conductivity reverse osmosis (RO) permeate to well water in the cooling tower makeup. Increasing to 9 cycles of concentration would save 15,000,000 gallons of water per year and reduce blowdown by 35%. This recommendation has no capital costs associated with it, because the existing RO system has the capacity to process this additional RO water.

Reprocess RO Reject for Cooling Tower Makeup

Research was conducted on the concept of adding a closed circuit reverse osmosis (CCRO) system to process RO reject water. The concept involved feeding the permeate water from a CCRO to the cooling tower as makeup water. It was found that this change would provide no resource or cost savings and is not currently recommended for Heartland Corn Products.

Solutions

Collect Evaporated Cooling Tower Water

Collecting evaporated cooling tower water is another way to provide low conductivity makeup water to the cooling towers. This opportunity must be implemented along with increasing to 9 cycles of concentration. Five to six percent of water evaporated by the cooling towers can be captured with plume abatement technology and used as makeup to offset some of the RO water used. An additional 15,000,000 gallons of water would be saved per year if implemented. This opportunity is not recommended since it will cost HCP $13,000 per year.

Recycle Waste Heat through Stack Heat Recovery

As air emissions are treated in the regenerative thermal oxidizer, waste heat is exhausted to the environment at HCP. Recycling the heat through a stack heat recovery system would result in annual energy savings of up to 8,820,000 therms. The recycled waste heat would be used to create low pressure steam to be sent to the evaporators used in corn oil operations. This is a future opportunity that requires further investigation.

"Heartland Corn Products was pleased to participate in the MnTAP program for the first time in 2022. It was impressive to see the wide variety of projects related to water use, energy efficiency, and waste reduction. The future looks bright for this group of interns whose efforts have made a positive impact for their host organizations and for our environment."

~Terry Wendorff, Plant Manager
Heartland Corn Products

Implement Cold-Adaptive Enzymes in Starch Hydrolysis

Enzymes are used in ethanol manufacturing to breakdown starch to glucose. Implementing cold-adaptive enzymes would reduce energy use and operating costs. This is a future opportunity that requires further investigation.

Recommendation	Annual Reduction	Annual Savings	Status
Increase to 9 Cycles of Concentration	15,000,000 gal water	$17,000	Recommended
Collect Evaporated Cooling Tower Water	15,000,000 gal water	None	Not recommended
Recycle Waste Heat through Stack Heat Recovery	8,820,000 therms	$4,410,000	Future Opportunity
Implement Cold-Adaptive Enzymes in Starch Hydrolysis	TBD	TBD	Future Opportunity

MnTAP Advisor: Laura Sevcik, Pollution Prevention Specialist