2015 24–WEEK PROJECT

CARGILL, INC.

CEDAR RAPIDS

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MECHANICAL ENGINEERING
THE UNIVERSITY OF IOWA

COMPANY PROFILE

Cargill is a privately-owned business that began in 1865 as a grain storage facility. It has grown to be a global producer and marketer of food, agricultural, financial, and industrial products and services. Cargill is committed to environmental stewardship and strives to be a good corporate citizen in the communities that it serves. The Cedar Rapids Corn Milling Plant works with customers and farmers to process raw corn into a diverse collection of marketable materials, foods, and ingredients. The Cedar Rapids, Iowa, plant operates three shifts per day and employs about 200 workers.

PROJECT BACKGROUND

The facility uses water from wells as a coolant for most of the machinery. As the coolant flows through the equipment, the coolant absorbs the heat and eventually discharges into the river. While the effluent is free of contaminants, the temperature can impact the natural environment. The purpose of this 24-week project was to evaluate methods to lower the temperature of the effluent in order to alleviate the impact of the warmer water on the environment.

INCENTIVES TO CHANGE

In the future, there will be new, required calculations for determining allowable temperature parameters for water discharged into designated waterways. These new calculations are expected to require a substantial reduction in the temperature of the effluent discharged into the river. Due to these upcoming calculations, Cargill would like to evaluate the current well water and cooling systems, research methodologies to improve the efficiency of the system, and determine areas of opportunity to modify the effluent temperatures.

RESULTS

The first stage of the project was to analyze the well water system in place by gathering water flow and temperature data throughout the process. The second stage of the project was to collect design specifications for critical equipment and study different cooling methods. The third stage of the project was to create tools from the collected data for use in meetings and brainstorming sessions where possible projects could be reviewed and executed.

Effluent Analysis: The intern catalogued all equipment that utilizes well water as coolant. Documentation included the proper identifications, location, and pictures of the equipment for ease of distinction. Using this resource, the intern catalogued the manufacturer's equipment information and collected the original drawings and specifications to be included in the equipment files. This catalogue of data will also be useful in the maintenance of equipment to ensure that the equipment is operating within its designed parameters. The intern created a flow diagram using software that creates a visualization of the system and monitors the flows and temperatures of the well water at different locations in the plant. The intern also created piping and instrumentation diagrams (P&IDs) to provide a detailed layout of the equipment, valves, sensors, pipe sizes, and flows of the well water. The P&IDs will be an essential resource in the analysis of the current system and for the planning of process modifications.

In addition to the equipment, the intern identified key areas for monitoring and recommended purchasing and installing flow and temperature sensors. The intern took daily measurements to establish trending during the hottest months, which helped to understand how much cooling capacity is required and where modifications in the system will be most effective.

The intern organized the collected data and used it to create a model of the well water system that predicts how the process will change when potential modifications are implemented. Research was done into the installation of floating spray coolers, geothermal cooling, and cooling towers. Quotes and information about these methods were compiled and cooling towers were determined to be the most feasible approach. Necessary process modifications for the installation of cooling towers were detailed and shared with the engineering team. Lastly, a final series of brainstorming sessions guided by the temperature trends, process flow diagram, and system model were held with the different department leaders and a list of potential heat recirculation projects was created.

The intern wrote a project proposal describing the capital investments, benefits, and required process modifications for the implementation of cooling towers in different areas of the facility. The table below shows the savings from reducing city water usage due to the implementation of the cooling towers.

PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
EFFLUENT ANALYSIS: COOLING TOWERS	$1,103,760	1,103,760,000 gallons	RECOMMENDED
EFFLUENT ANALYSIS: COOLING SYSTEM ANALYSIS AND DOCUMENTATION	$72,000 (one time)	18,438 kWh	IMPLEMENTED