



## NATHAN SMITH

**SCHOOL:** Iowa State University

**MAJOR:** Chemical Engineering

# CAMBREX CHARLES CITY

## 2022 FALL COOP PROJECT



CHARLES CITY

### COMPANY PROFILE:

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

### PROJECT BACKGROUND

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



### INCENTIVES TO CHANGE

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

### RESULTS

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

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

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



**Direct Steam Injector PM:** CCC has an onsite wastewater treatment plant. During the cooler months, a direct steam injection (DSI) system keeps the influent heated to a temperature where the microbiological organisms can function efficiently. DSI heaters benefit from preventative maintenance (PM) plans, which keep them operating efficiently by preventing excessive steam use and relieving stress on

the boiler. With a new DSI heater being installed in 2022, the intern developed a detailed PM plan to maintain optimum efficiency of the tube. Preventative maintenance on the DSI will be done twice a year, before startup and after shutdown. A draft of the PM plan was submitted to the reliability engineer for review and finalization before being entered into the company’s PM system.

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

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

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

## ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

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