

SHOWCASE PROJECT: AGROPUR: REFRIGERATION UPGRADES

SOLUTION OVERVIEW

Le Sueur Cheese is one of seven Agropur cheese and whey protein drying plants in the United States. In 2010, Le Sueur Cheese joined the Better Buildings, Better Plants program and set a goal to reduce its energy intensity by 25% over a 10-year period.

One of the larger energy users at Le Sueur Cheese is in refrigeration. Because cooling is known to be very energy intensive, it was an obvious area to look at when searching for ways to improve efficiency. A study was commissioned to identify areas of the refrigeration process where energy efficiency could be improved.

The Le Sueur plant uses an industrial refrigeration system with ammonia as the refrigerant. Ammonia refrigeration systems, like all vapor-compression refrigeration systems, are made up of a number of components working together. The required components are compressors, condensers (heat exchangers), expansion device, and evaporators (heat exchangers). Previously, the plant had three compressors and two heat exchangers which required an ice bank to supplement cooling needs for two undersized plate and frame water/ammonia heat exchangers. The purpose of these exchangers was to provide the plant with chilled water at 35 degrees F.

Although the selected upgrade option cost significantly more than the standard practice of installing an additional heat exchanger, the energy savings alone are expected to pay back the initial installation within two years. The project took six months to complete and reduced the overall electric load for the plant by over 2,040,000 kWh annually, an approximately 40% reduction.

SECTOR TYPE

Industrial

LOCATION

Le Sueur, Minnesota

FINANCIAL OVERVIEW

\$286,000

SOLUTIONS

The plant commissioned a study in June of 2017 to identify areas to improve energy efficiency. Previously, suction pressure was being run at 20.4 PSI to build the ice in the ice bank to optimal levels. In order to increase the efficiency of the system, it was decided to increase the ammonia

suction pressure to 35.6 PSI, which is the pressure going into the compression step of the refrigeration cycle. Increasing ammonia suction pressure reduces system lift, which is the difference between suction and discharge pressures within the system. A reduction in lift accomplishes the following:

- Reduces the overall work required by the compressors
- Increases compressor capacity
- Increases overall system efficiency

In order to achieve the higher ammonia suction pressure, the following work was undertaken:

- Removal of the ice bank cooling unit
- Replacing the existing heat exchangers with larger ones, which increased the system capacity
- Increasing the chilled water line size, which required extensive re-piping work

It was determined that by replacing the two existing plate and frame heat exchangers with two new plate and frame heat exchangers that have approximately 50% more capacity and run at a higher suction pressure, the plant will no longer need the additional cooling from the ice bank to generate 35F chilled water.

Financially, the project cost \$286,124, as broken down below.

- \$243,675 to provide all labor, material, and engineering to have new plate heat exchangers installed.
- \$25,899 to provide labor, material, and installation of new 8" water lines.
- \$16,650 to remove the existing ice bank.

OTHER BENEFITS

Plant personnel found that due to the increased system capacity, the plant has the ability to operate with only one ammonia compressor for a majority of the winter season, and only two during the summer. Not only has this resulted in more energy savings than expected, it has decreased system maintenance requirements. Additionally, the system will already be equipped with extra capacity in the event that the Le Sueur Cheese Plant needs to expand in the future.

Because energy savings were greater than 1,000,000 kWh, the City of Le Sueur's electrical department required a formal measurement and verification process to be completed before rebate dollars were distributed. Once the additional forms were submitted and reviewed by the State of Minnesota's Center for Energy and Environment (CEE), a rebate of \$64,000 was given to the plant for this project.

Overall, this project highlighted the fact that once the limiting factor was identified in the ammonia refrigeration system, the plant made a determined effort to look at all options in an attempt to eliminate it. It also highlighted the fact that, as a company, Agropur is not afraid to tackle these obstacles and come up with creative and innovative ways to improve overall performance. Further,

now that Le Sueur Cheese has proven what the true savings are for solving ammonia refrigeration issues, it gives confidence in management to release capital dollars to other plants to implement similar projects.

Annual Energy Use

Baseline()



Actual()



Energy Savings

40%

Annual Energy Cost

Baseline()



Actual()



Cost Savings

\$157,000



Undersized heat exchanger that required 20.4 psi suction pressure to maintain a 35F chilled water supply.



Properly sized heat exchangers that can maintain 35F chilled water supply with a 35.6 psi suction pressure.