

St. Croix Forge



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Company Background

St. Croix Forge was founded in 1984 by Curt Carlson in Forest Lake. Through the 1990s, the company developed into one of the largest horseshoe manufacturers in North America. In 1999, it was bought by Mustad Hoofcare, a company that originated in Norway in 1832 making small metal objects. Mustad has since acquired other companies and merged to become Delta Mustad Hoofcare Center. Each part of the company is focused on horseshoes and/or horseshoeing implements. They operate in 16 countries, and St. Croix is one of 11 affiliated factories. Mustad products are sent to nearly 100 countries worldwide. Today, St. Croix Forge produces steel horseshoes for racing, sport, and all-around riding. They employ about 50 people at the plant.



“This internship allowed me to transition from the hypothetical to the real application of my knowledge under real world conditions. Not only did I gain experience putting my knowledge into practice, I also learned about aspects of engineering that I had little exposure to in my major-specific classes.”

Project Background

The goal of the project was to identify, evaluate, and justify ways to reduce process energy and material use at the forge. The project focused on the utilization and optimization of pumps used in a process cooling application, improvements to the utilization of an air compressor, improved process lubrication, and minimization of steel use in a product.

Incentives to Change

The primary motivation in pursuing the intern project was to reduce material consumption and energy usage. The forge uses, on average, 4,600,000 kWh of electricity and 7,465 therms of natural gas per year.

Solutions

Optimize Process Cooling Pumps

Four water circulation pumps are used to keep the forge induction heaters and electronics cool in a fairly complex piping system. I modeled the current operations and

several alternative configurations all of which used existing components as much as possible to minimize the capital cost of recommended changes.

My analysis showed the system can operate much more efficiently with just two of the existing pumps, new variable speed drives, and valves to allow flow only to forges that are operating. This can reduce pumping cost by 80%.



Based on the magnitude of savings identified, a contractor was invited to submit a proposal, and they suggested rebuilding the circulation system. Though this is a more costly option, it would significantly simplify the piping, reduce friction losses, and correct some short-comings of the original system.

Disable Older Cooling Tower Fans

In the hydraulic cooling system, after the water returns from the production lines, it is sent to the cooling towers to discharge some of its heat energy. St. Croix has three cooling towers: two older towers and one newer tower, which has two fans. The older towers have had their spray water capacities disabled and now have only two modes of operation: fans on and fans off. Tests showed having the fans on made almost no difference in the cooling capabilities of the old towers. At my recommendation, these two 5hp fans were disabled. Once a PLC is put in place, I also recommend experimenting with turning on the newer, 10hp fans one at a time.

Reduce Grease Application Rate

Grease is used to lubricate multiple moving parts on each forge. It is distributed through blocks, which eject fixed volumes to ten locations on each forge, for each one to



two horseshoes produced. The used grease coming out of forge contact areas was still clear, indicating that less grease might be sufficient. Since the volume of grease applied by the blocks cannot be decreased, we ran a test reducing the frequency of the grease application by 35%.

Grease analysis showed no metals present from wear and grease application was reduced by another 20% on the test forge. If the used grease comes back clean again, I recommend decreasing the other five presses by 55% and setting the rate of the test press to 1 stroke per 18 cycles (36% of the baseline grease application rate). This will have the immediate effect of saving \$12,510 per year. If after further testing the reduced rate press has too much wear, it can be set back to 1 stroke per 12 cycles. In this case, the savings are less, but still significant at \$11,190 per year.



Replace Evaporator

The evaporator is used to separate oils and possibly metals from air compressor condensate and wastewater from various pressure washers. This reduces the volume shipped for safe disposal. The current evaporator is heated electrically (draws 20.8 kW), is expensive to operate, and can only evaporate about 5 gallons per hour. St. Croix evaporates about 4,000 gallons of water per year. There are two gas-fired replacement options, one bigger and one smaller. I recommend purchasing the smaller, 15-gallon evaporator. Both new gas-fired evaporators would use the same amount of energy at the same operating cost, and both evaporate faster and at a lower cost than the current electric unit. But the smaller evaporator has a lower initial investment. The current evaporator is operating at a slower rate than promised by its specifications and will likely continue to slow the longer it is used.

Recommendation	Reduction	Annual Savings	Status
Optimize process cooling pumps	242,400 kWh	\$20,580	Under review
Disable older cooling tower fans	6,520 kWh	\$550	Implemented
Reduce grease application rate	5,700 lbs grease	\$11,190+	Testing
Replace evaporator	913 kWh	\$1,020	Under review