hydro THERMAL®

STEEL MILL SAVES 60%
IN ENERGY COSTS WITH DSI

About the Mill

This large U.S. Steel Mill, with international locations, operating as a steel sheet finishing operation and specializing in tin coating, is a major supplier to the canning industry. Products made at this location are chrome and tin-plated steel. Markets served include container, construction, and service centers.

Goal: Find Ways to Save Energy

This mill voluntarily went into an Energy Savings Assessment (ESA number withheld) with the United States Department of Energy (DOE) in 2005 to understand their processes and look for key process heating savings opportunities. As part of this plan, the mill conducted pre-assessment measurements and collected data after implementing planned process changes.

One goal was to reduce the steam used to make hot water in the tin mill. The old system included an aged Cochran steam sparging water heater and a large sparged hot water storage tank heated to 200°F [93°C]. Water demand was 600 GPM [136 m^3/hr] for one operating cleaning line in the continuous annealing (CA) process, consuming about 19.4 Klbs. steam/hr or about 23 MMBTU/hr at 180 psig [12.4 barg] of steam pressure for a discharge water temperature of 180°F [82°C].

At first, the mill planned to lower this consumption by reducing the water temperature to 120°F [49°C], thus decreasing BTU requirements and saving energy. This, however, was not a good solution, as the water for the continuous annealing process needed to be constant and heated to 180°F [82°C].

Goal: Find Ways to Save Energy

Besides the impressive energy savings features of the Hydroheaters, several secondary features of the proposed system peaked the interest of the project team as well.

1. The Hydroheater® skids were compact and would save floor space. Because of this compactness, the old storage tank would not have to be dismantled immediately, and, even though an eyesore, taking it out would have been a significant project and a set-back for the schedule.
2. They could produce instant on-demand hot water eliminating the need to store and reheat the water.
3. Destructive steam-hammer vibration on cold start-up would be eradicated.
4. The units were affordable, and installing a back-up heater was cost-effective insurance against any unforeseen line shutdown.
5. The Mechanical Manager at the mill liked the low maintenance of the internally modulated Hydroheaters that could handle the river water and superheated steam.
6. The ability to precisely control the temperature was also a huge bonus feature of the heaters.
7. There would be secondary maintenance savings on other equipment affected by high humidity from the storage tank, which would no longer escape from undissolved sparged steam within the lower level. 100% of the steam is dissolved into the water as it discharges from a Hydroheater.
8. The Manager of Utilities was impressed with the reasonable price and the fact that steam and water meters could easily be installed to track energy usage for reporting the ESA progress.
9. He also liked the on-demand feature and saving steam when not in use.

Having done preliminary calculations and knowing the current system's inefficiencies, he was anxious to find out how much energy they could save. "From early indications, we should see some real savings on steam use to the tune of $50,000/month," he stated.

Engineers specified three internally modulated Hydroheater skids to supply the mill's need for hot water in the continuous annealing lines. The DSI heaters would require less than half the steam consumption to heat the same amount of water to the needed temperature of 180°F [82°C], and they could control the water temperature to this exact set-point.

Project Results

In January of 2008, Hydroheater skids were installed in-line to replace the sparger and water tank. The skids now provide consistent 180°F [82°C] water at a flow of 150-180 gpm [34-40 m^3/hr] to wash the rolled tin in a continuous web process (2000 linear ft/min) before it enters the four-story electric annealing furnace.

Preliminary readings saw steam usage drop from 19,400 PPH to 7,900 PPH! This resulted in an energy savings of nearly 60%.

The annealing lines change production schedule to meet shipping requirements, but on average, the lines run 96 hrs/wk and now consume approx. 7,900 lbs steam/hr or about 9.5 MMBTU/hr compared to the 23.3 MMBTU/hr before the heaters were in use.

Months later, the energy usage readings confirm this savings, equating to over $600K/yr. As energy prices escalate, the savings of using the Hydroheaters will continue to grow.

	BASE DATA	CURRENT DATA	SAVINGS	% SAVINGS
PPH Steam	19,400	7,900	11,500	59.3%
MMBTU/hr	23.3	9.5	13.8	59.3%
Average Run Time/Week	96%	96%		
Total Hours/Year	4,992	4,992		
$/BTU	10.0	10.0		
$/klb Steam	12.0	12.0		
PSIG Steam	180			
Dollars Spent on Steam/Hour	$232.80	$94.80	$138.00	59.3%
$/Year Used	$1,162,138	$473,242	$688,896	59.3%

Energy readings before and after DSI heater installs

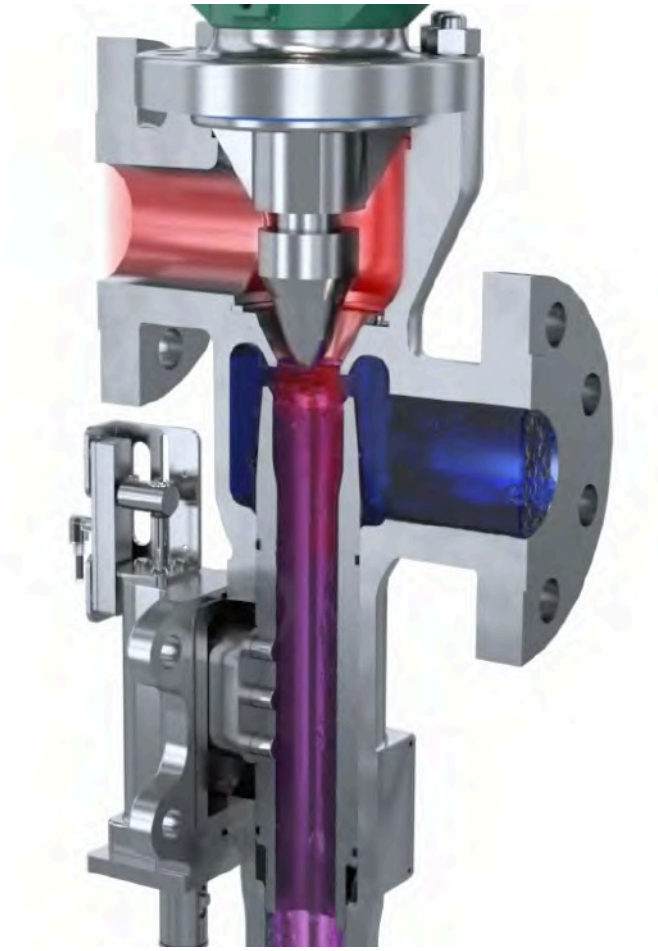
How Direct Steam Injection Works in this Application

This mill previously used an inefficient sparging process to heat water and stored it in a large sparged tank. Spargers are not designed to confine the mixing process to a specific region. Therefore, temperature variations readily occur—both of these sparged elements allowed for much energy to be released into the atmosphere.

Using the Hydroheaters, the mill can benefit from the patented technology of internal modulation steam heating. The DSI heaters are directly plumbed into the process line and require much less floor space than the old heater and storage tank. This system injects precisely metered amounts of steam into the process fluid through a variable-area steam nozzle. The nozzle design ensures constant steam pressure and velocity at the point where steam contacts the liquid, eliminating the potential for pressure upsets and ensuring smooth heater operation. The Hydroheaters are self-cleaned by sonic velocity steam, so they do not foul or scale.

The direct steam injection uses 100% of the latent and sensible energy in steam. A DSI heater's BTU requirement to heat the same amount of liquid is greatly reduced compared to indirect heating methods or spargers.

An energy usage estimate was calculated using the Churchill method—knowing the vessel characteristics, temperature conditions, and operating conditions, and energy loss calculation was formulated. This calculation, done in the planning stage, showed an estimated ROI of about ten months for the skids. With actual readings after installation, the energy savings resulted in an ROI of only 55 days for all three skids, or less than one-month each. Apparently, the old system was more inefficient than anticipated.



Internal View of DSI Heater

Conclusion

Hydroheaters by Hydro-Thermal were the best option for this site. Not only did the skids pay for themselves in less than two months with energy costs alone, but DSI allows the mill to continue saving on maintenance, time, space, and ensures product quality by precisely heating the water to exacting temperatures.

Through their energy conservation efforts, the mill has gone from a historic high of 450 Klbs. steam/hr to 315 Klbs. and the Manager of Utilities is aiming to reduce that to 215 Klbs. steam/hr in the future. Clearly, an annual savings of 11.5 Klbs/hr amounting to over $600K in the CA lines alone is a successful energy reduction effort.

The mill is currently evaluating other areas where DSI could help save even more energy and other costs.

About Hydro-Thermal Corp.

Hydro-Thermal Corp. manufactures a range of direct steam injection heaters for a variety of heating applications. Over the years, they have adapted their technology and expertise to serve customers in the primary metals, pulp and paper, chemical, textile, pharmaceutical, food and beverage, biotech, grain milling, Biofuels, petrochemical, and water treatment industries. Hydro-Thermal offers engineered solutions for every liquid heating application. The company holds patents on several internal modulation DSI heaters including the self-cleaning and straight through design heaters used for thick slurries.

Need more information about Hydro-Thermal products?
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