EXPLORING CIP APPLICATIONS IN ETHANOL PRODUCTION

Replacing Spargers = Major Cost Savings

Located in Monroe, Wisconsin, Badger State Ethanol is a dry mill ethanol production facility producing 58 million gallons of ethanol per year. They currently use the Hydroheater and the Autopilot to optimize their residual starch levels.

In ethanol facilities, clean-in-place (CIP) is an essential application that is often overlooked. If ethanol producers do not have enough hot water through their CIP process, the batch could become contaminated, resulting in wasted product. To counteract this problem, ethanol producers heat the water hotter or add more expensive and inefficient chemicals.

Badger State previously used an inefficient sparging system for their CIP applications. Sparging causes uncondensed steam bubbles to evaporate in the atmosphere, wasting large amounts of energy. This lost heat/condensate can corrode piping and ceilings. Steam bubbles form and cavitate on tank walls, causing hammer and damage to the tank and surrounding piping. Badger State experienced these problems and more - sparging nozzles completely breaking off during operation, rust on the high beams of their ceiling, and damage to the tank due to violent shaking.

Hydro-Thermal talked to Badger State about how they were currently heating their water and introduced the idea of energy savings using Hydro-Thermal's technology. Badger State decided to replace their inefficient sparging system with a Hydro-Thermal EZ Heater Skid (EZ Skid). The EZ Skid reduced their maintenance needs by requiring minimal service only once a year and eliminated the cavitation and hammer issues faced with the sparging.

Badger State also noticed a reduction in their boiler makeup water. Doug Friedrich, Badger State Ethanol's Operations Manager, elaborated, "When we first put the EZ Heater on line, our boiler makeup water dropped by a gallon and a half. It is normally 35 gallons a minute, and it dropped to about 33 and a half."

> "We are heating the water hotter than we did with the sparger, but we are using less steam and less makeup water. Cleaning is all about time, turbulence, and temperature. If you can keep a hotter temperature, which the EZ Heater can do, then it must be an improvement. With the EZ Heater, the temperature will stay hotter throughout the process which is also a definite benefit."
>
> – Doug Friedrick, Operations Manager

The reduced boiler makeup water verified the reduced steam usage. Due to the reduction in their boiler water, Badger State experienced a total savings of $32,045 per year. Detailed breakdowns of the cost savings calculations are located at the end of this article. With sparging, Badger State was heating the tank to its maximum temperature. Due to higher efficiency steam mixing, Badger State can heat the water hotter while using less steam. Although heating the water hotter may not cause drastic steam savings, it ensures a more consistent CIP.

Badger State is improving its product quality and ethanol production process thanks to its strong business relationship with Hydro-Thermal. Hydro-Thermal offers systems for a wide variety of applications ranging from water heating to precisely cooking products. The skidded systems include all the necessary components and eliminate unnecessary work for the customer. Hydro-Thermal works side-by-side with its customers to review their heating processes and find the most effective solutions as a total solutions provider.

Calculation

Given that the average makeup water flow has reduced by 1.5 gpm since the implementation of the EZ Heater Skid at Badger State Ethanol, the following calculations can be made:

Fuel Savings

Fuel Costs - $4.00/1000# steam
82% boiler efficiency
350 operating days per year at 24 hours per day

$$1.5 \frac{GAL}{MIN} \times 8.34 \frac{LBS}{GAL} \times 60 \frac{MIN}{HOUR} \times 24 \frac{HOUR}{DAY} \times 350 \frac{DAY}{YEAR} = 6{,}305{,}040 \frac{LBS}{YEAR}$$

$$\frac{6{,}305{,}040 \frac{LBS}{YEAR}}{82\% \text{ Boiler Efficiency}} = 7{,}881{,}300 \frac{LBS}{YEAR}$$

$$4.00 \frac{\$}{100 \text{ LBS Steam}} = 7{,}881 \frac{1000 \text{ LBS}}{YEAR} \quad = \mathbf{31{,}525} \frac{\$}{YEAR} \text{ Fuel Savings}$$

Water Savings

Water Treatment Costs - $0.30/1000# steam
Water Costs - $1.50/1000 gallons water

$$1.5 \frac{GAL}{MIN} \times 60 \frac{MIN}{HOUR} \times 24 \frac{HOUR}{DAY} \times 350 \frac{DAY}{YEAR} = 756{,}000 \frac{GAL}{YEAR}$$

$$1.50 \frac{\$}{1000 \text{ GAL Water}} \times 756 \frac{1000 \text{ LBS}}{YEAR} \quad = \mathbf{1{,}134} \frac{\$}{YEAR} \text{ Water Savings}$$

$$0.30 \frac{\$}{1000 \text{ LBS Steam}} = 6{,}305 \frac{1000 \text{ LBS}}{YEAR} \quad = \mathbf{1{,}891} \frac{\$}{YEAR} \text{ Water Treatment Savings}$$

Pump Costs

Electricity Costs - $0.08/kWh
5 HP motor on recirculation pump

$$5 \text{ HP} = 0.7456 \frac{KW}{HP} = 3.728 \text{ KW} \qquad 3.728 \text{ KW} \times 24 \frac{HOUR}{DAY} \times 350 \frac{DAY}{YEAR} = 31{,}315 \frac{KWh}{YEAR}$$

$$31{,}315 \frac{KWh}{YEAR} = 0.08 \frac{\$}{KWh} \quad = \mathbf{2{,}505} \frac{\$}{YEAR} \text{ Electrical Costs}$$

Totals

$$31{,}525 \frac{\$}{YEAR} + 1{,}134 \frac{\$}{YEAR} + 1{,}891 \frac{\$}{YEAR} - 2{,}505 \frac{\$}{YEAR} = \mathbf{32{,}045} \frac{\$}{YEAR}$$

Need more information about Hydro-Thermal products?
Go to www.hydro-thermal.com or
contact us at info@hydro-thermal.com

400 Pilot Court | Waukesha, WI 53188
(262) 548-8900 | (800) 952-0121