



SINCE 1934
A HERITAGE OF STEAM INNOVATION

OPTIMIZE TANK HEATING AND IMPROVE UPTIME WITH A MORE RELIABLE SOLUTION

Achieve Exact Temperature Setpoint within the Tank

- > To begin gelatinization process
- > To optimize enzyme effect
- > Maximize heat balance throughout process
- > Maintain temperature consistency

Effective Steam Mixing

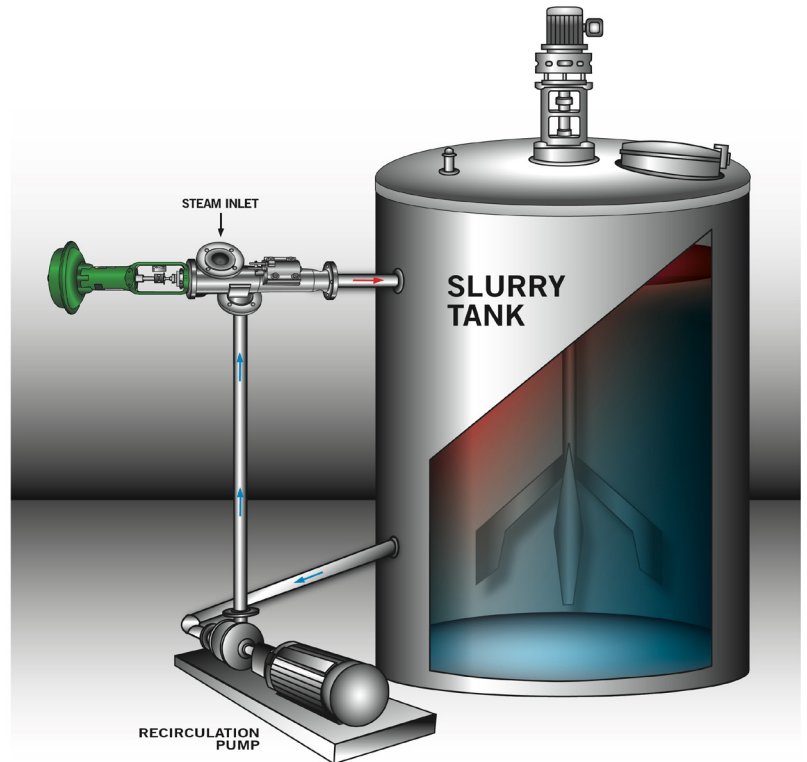
- > Eliminate hotspot from steam sparger
- > Ensure uniform temperature within tank
- > Minimize Maillard reactions of slurry
- > Eliminate doughballs

Maximize Steam Effectiveness

- > Condense all steam
- > Eliminates steam escape from tank

Eliminate Tank Damage from Unsophisticated Sparger System

Control Shear Effect on Starch to Maximize Conversion



Additional Slurry Tank Hydroheater System Offering:

In an effort to continue improving upon our slurry tank Hydroheater design, we are offering an optional system upgrade. This offering includes installing two additional manual isolation valves and a single section of piping from the existing slurry pump to our new pump as part of the slurry Hydroheater project. This upgrade is focused on providing our customers with built in system redundancy, improved reliability and reduced front end downtime. This system upgrade will allow the plant to run through our pump while also utilizing our heating system without process interruptions. This would be utilized in planned or unplanned outage events that require repairs to the primary slurry pump.

MEASURABLE DATA

A current installation of a Hydroheater for a slurry tank process, operational for more than two years, has shown the following results:

Ethanol Yield

With all other parameters and controls untouched, yield of ethanol volume per bushel of corn is the premier objective.

A 1.4% increase in yield (0.03 increase gallons/bushel) of ethanol was reported. At a 55Mgal/yr plant, this would result in ~\$875,000 added revenue.

Optimized Enzyme Usage

Scorched enzyme will deactivate when exposed to overheated areas in the slurry tank. Condensing steam immediately to transfer the steam's energy to the slurry is critical to minimize temperature stratification.

"Hydro-Thermal's innovative slurry tank heating method helped us optimize our enzyme usage resulting in a 10% reduction," said Doug Friedrich, Operations Manager at Badger State Ethanol.

Co-Product Development

For some producers, co-products generate more value than even the production of ethanol. Effective jetcooking will separate oil more purely and catalyze the separation of protein because starch is converted more homogeneously and completely. Also important is the minimization of Maillard reaction or retrograded starch "scorching" in the process creating undesirable compounds.

"The value of our coproducts increased because of their purity. To measure the effect, the residual starch content in the DDGS went from 4.5% to 3.2%; this is reflective of increased yield (those starches to ethanol) and higher value co-products".

Liquefaction HPLC Data

Effective conversion means increase in targeted sugar chains and less variation.

DP4 long sugar chains increased by four points, indicating improved enzyme effect and increased alcohol yields.

Beer Mash Temperature

Downstream Heat Exchangers are more effective, because of higher thermal conductivity, allowing mash to cool and beer to cool, thereby requiring less steam addition in distillation.

The heat exchange increased transfer by 1.8 deg F, resulting in 5,235 MMbtu/yr energy reduction in steam usage, or at Aug 2014 gas prices saved \$25,000 per year in fuel costs.

Liquefaction Pump Pressure Variation

Correlating with the control valve setting, the slurry tank pump discharge pressure will be reduced when slurry viscosity is reduced, thereby requiring less energy. Reduced viscosity and better mixing means easier starch conversion or yield.

A 2.4 PSI reduction in discharge pressure caused the pump to work less, creating additional energy savings and a more complete starch conversion.

Flow Control Valve Setting

An empirical value for a non-discrete parameter, the control valve will be closed more when the starch viscosity in the slurry tank is lower.

To create the same pressure feed, the valve was closed 4%.

CO₂ Scrubbers

In a typical process, cook water is returned to the slurry tank from CO₂ Scrubbers containing about 3% ethanol. In the slurry tank, the sparging ring causes a rolling boil that lifts the ethanol thereby causing losses and unwanted dangerous vapors.

"The slurry tank heating installation eliminated those vapors from exiting the tank, and eliminated the need for a costly recovery system or combustion system."