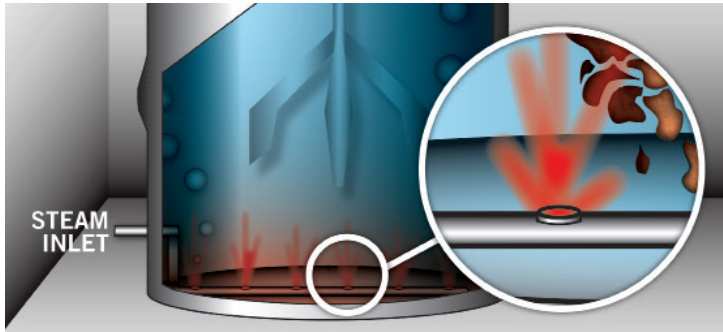


## DISADVANTAGES OF THE CURRENT HEATING SYSTEM

Although using steam sparging nozzles for slurry tank heating is the current industry standard, there are many issues associated with this heating method that can drastically impede the starch conversion process.



- 1. RETROGRADED STARCH AND DENATURED ENZYMES** Steam temperatures in an average ethanol plant can get up to 350°F. When both starch and enzymes come in contact with these temperatures, the results can be detrimental.
- 2. POOR TANK TEMPERATURE CONTROL** By injecting all of the steam at the bottom, there is risk of inconsistent temperature throughout the tank. A majority of the heat will be absorbed at the bottom, and much less heat will reach the surface. This causes enzymes to not be at optimal temperature during the retention time and less starch will be broken down.
- 3. CAVITATION** When steam is not mixed thoroughly, steam bubbles can collect and form into larger bubbles. When the large steam bubbles come in contact with the tank, they will rapidly condense. Cavitation will eat away the steel walls and the tank will eventually start to leak. Damage to the tank from steam cavitation is very common at most ethanol plants and can result in high maintenance costs, or in some cases, the need to replace the tank altogether.
- 4. LACK OF STEAM CONDENSATION** Steam may not condense into the slurry and has the potential to go right through the tank up to atmosphere. This increases energy costs since the energy used is being wasted.

## ADVANTAGES OF HEATING WITH A HYDROHEATER

Installing a Hydroheater on a recirculated loop around the tank can resolve all of the issues listed in the current heating system

disadvantages, as well as adding the below advantages.

- 1. HIGHER QUALITY STARCH CONVERSION** Although 350°F steam is being injected into the product, the instantaneous condensation of the atomized steam bubbles prevents hot spots from occurring and results in a consistent 185°F temperature directly at the Hydroheater discharge. This prevents the enzymes from being denatured and retrograded starch from forming. This results in better enzyme utilization and higher quality starch for conversion.
- 2. ACCURATE TEMPERATURE CONTROL** When using a Hydroheater for slurry tank heating, all of the slurry will enter the tank at the correct temperature, and there will be minimal temperature stratification across the tank. This will allow the enzyme activity to be optimized for the full retention time required and will result in higher starch conversion before the downstream Jet Cooker.
- 3. REDUCED MAINTENANCE** Keeping all of the steam injection contained at one point will prevent damage to the tank from sparging. It will reduce the amount of maintenance hours required for fixing the slurry tank.
- 4. ENERGY SAVINGS** All of the steam will be condensed in the Hydroheater before it is discharged back into the slurry tank and no steam will be lost to atmosphere. This will reduce the amount of steam needed for the same temperature rise and there will be lower fuel usage at the boiler.
- 5. PARTICLE SIZE REDUCTION** The additional shear point added to the process will help reduce the particle size, and break up “dough balls”. This will allow a larger surface area for enzyme contact for the full retention time which will improve the starch conversion process.
- 6. 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.