Campaign 4
Problems & Resolutions

UF Stan Mayfield Biorefinery Pilot Plant

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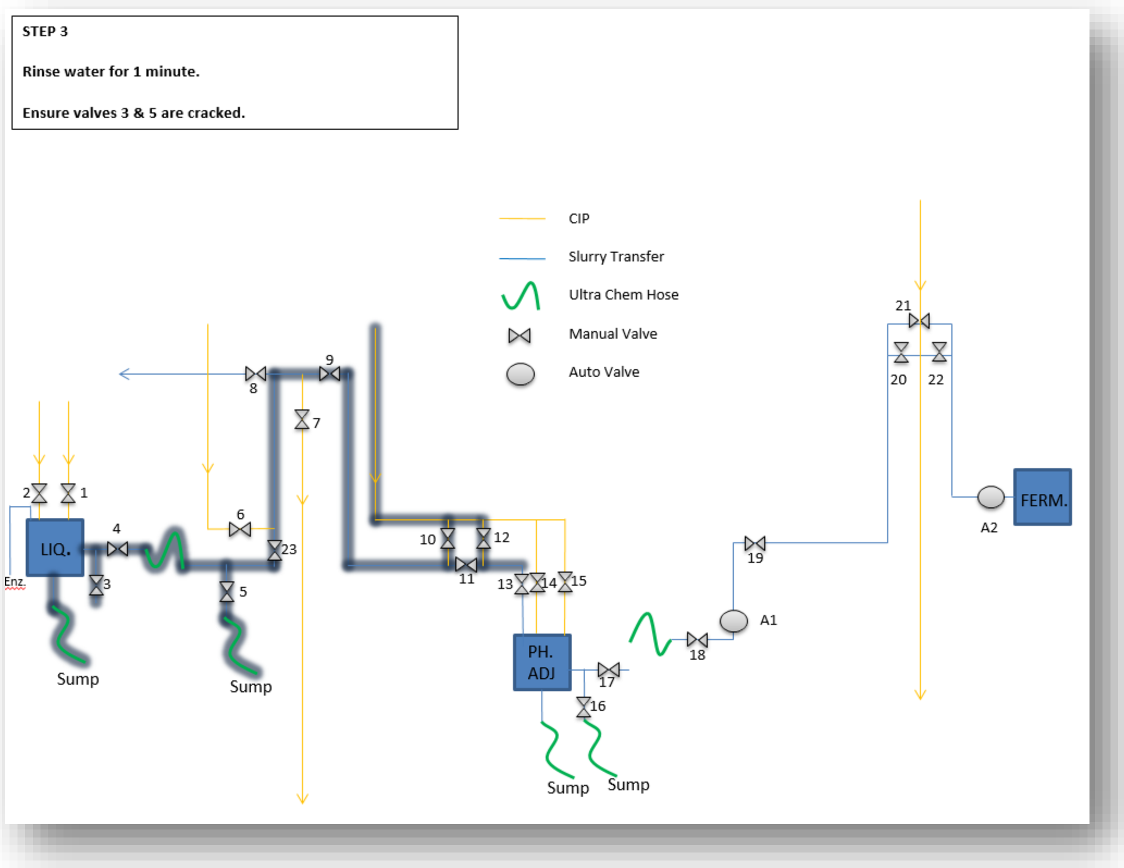
I. Fermentation Contamination

Problem

During Campaign 4, contamination was evident in the fermentation. It was most likely due to a residual pocket of slurry from Campaign 3. The pocket was in the middle of the transfer line between the liquefaction and pH adjustment tanks.

Resolution

A new, much more comprehensive CIP/SIP procedure. Transfer lines, including tough pockets and dead ends, will now be cleaned and sterilized. Our new Quick Procedures (QPs) supplement our SOPs to enable a quick and proper CIP/SIP once a campaign is over.



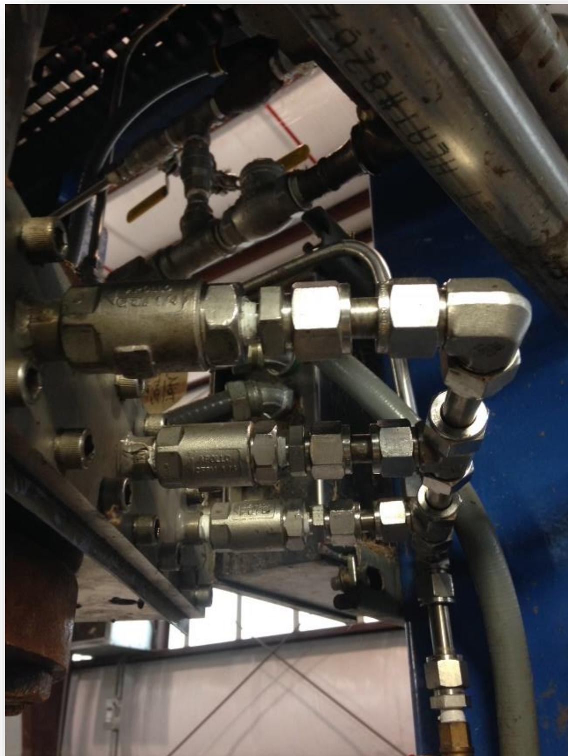
Status

Resolved for now.

II. Pretreatment Bottom Knife Gate

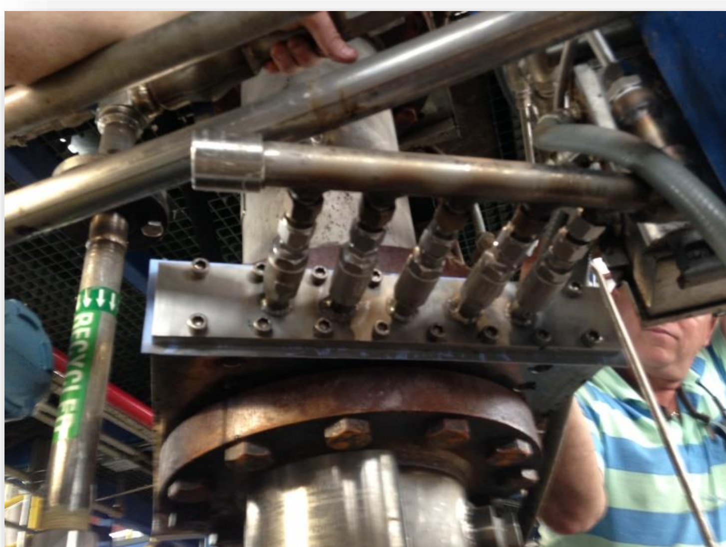
Problem

During Campaign 4, the bottom knife gate valve started leaking pressure near the end of its required run time. This was due to biomass clogging the insertion space. Our three-port blow-out was not working well enough.



Resolution

Install two more blow-out ports, nearer to the edge of the insertion space.



Status
Resolved for now.

III. Propagator Foaming

Problem
During Campaign 4, upon filling the propagators with water and hydrolysate, our level readings read inaccurately. The inaccurate readings led to a substantial deficiency in the amount of hydrolysate added to propagator 3, which in return resulted in an overgrown seed. The inaccuracy in readings were due to excessive foaming from the spargers.

Resolution
Sterile antifoam must now be added to the propagators if the spargers are to be used.

Status
Resolved.

IV. Loss of Ethanol

Problem
During all previous Campaigns, sparging and air injection into the head space likely blew some ethanol out the vent of the fermentor.

Resolution
A shell and tube condensing tower for the fermentor was fabricated at our own workshop.

Status

Resolved.

V. pH Adjustment Level Sensing & Mixing

Problem

Campaign 4 was our first attempt at using two pH probes in pH adjustment. To do so, we had to keep the level above 80%. This level was found to be too close to call for the level sensor, and it eventually became submerged. It became submerged due to issues with continuous pumping of slurry. The level sensor is a cone which protrudes down from the top of the tank. It uses radar and does not read correctly when covered in slurry. Minutes after we stopped to troubleshoot a clog between pH adjustment and fermentor C, the pH Adjustment tank completely overfilled and pressurized the tank. The overfilling led to a popped rupture disc, dirty vent line and clogged vacuum breaker (we did not discover the dirty vent line and clogged VB until much later.) During the whole event, the level reading in the control room was inaccurate.

In addition to the inaccurate level reading, it was found that at the higher levels the mixing was insufficient at keeping the slurry homogenous. Looking through the sight glass, it was obvious that the mixing was poor when the level was high. The pH readings disagreed as well, which indicated the top was not being mixed well.

Resolution

A new procedure was established to keep the level in the pH adjustment tank below 50%. This allows for only one pH probe, but better overall mixing and much less risk of overfilling and covering the level sensor.

Status

Resolved.

VI. Transfer Lines

Problem

During Campaign 4, we experienced clogging in the transfer lines between Liquefaction, pH adjustment, and the fermentor. This Campaign was our first using an enzyme dosage of 5% (decreased from 10%), which may have contributed to the difficulty in pumping. It was seen that the enzyme digestion was not as effective as past Campaigns, which supports the idea that the lower enzyme dosage contributed to more difficult pumping. In addition, the slow flow rates allowed for solids to settle out along the transfer lines.

Resolution

One possibility would be to increase the severity of pretreatment to allow for a more complete digestion, but the yields of sugar released were not at a low enough point to consider this option. Instead, we created procedures to keep very close tabs on the pressure in all transfer lines. If clogging begins, we reverse the pumps to prevent further clogging. In a commercial facility, the flow rates would be high enough such that clogging would likely not be a problem.

Status

Resolved for now.

VII. CIP of Nutrient Addition Lines

Problem

Prior to Campaign 4, we did not have a way to run all 3 CIP mediums through the nutrient addition lines for Prop 3 and the respective fermentor.

Resolution

Install ½” tubing from nearby CIP supply line to allow us to do so.

Status

Resolved.

VIII. Decanter Clogging

Problem

During Campaign 4, the decanter solids were still clogging, as expected, but clearing out the clogs via the newly installed port door was not working.

Resolution

We got rid of the metallic tapered chute and installed a hanging tarp. This allowed the solids to fall easily to the bin on the ground floor.

Status

Resolved.

IX. Nutrient Pump Flow Rate

Problem

During Campaign 4, the peristaltic nutrient pumps were struggling to maintain a constant flow rate.

Resolution

New tubing.

Status

Resolved.

X. Wastewater Pump Clogging

Problem

During Campaign 4, the wastewater pump started to clog up worse than ever. It became clear that it was happening after the pump was turned off, because solids from the tank could settle within the pump head.

Resolution

A new procedure to ensure the main drain valve to the tank (prior to pump) is closed, and that the pump is washed out after use.

Status

Resolved.