Campaign 7
Problems & Resolutions

UF Stan Mayfield Biorefinery Pilot Plant

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I. No Growth in Propagator 3B

Problem

During Campaign 7, there was very little growth in the Propagator 3B. The likely reasons are:

- Inoculation from Propagator 2B was done too early, and the shock to the cells caused very slow growth.
- The transfer lines were still hot from the sterilization (SIP) done on Propagator 3B.
- The nutrients were not prepared or added correctly.

Resolution

See the following resolutions for each possible reason:

- Ensure the cells are at a stage of growth acceptable for inoculation.
- Add a section in the Propagator 3 SOP to cool down the transfer lines after sterilization (SIP).
- Add a section to the quality control procedures to ensure the nutrients are prepared and added correctly.

Status

Resolved.

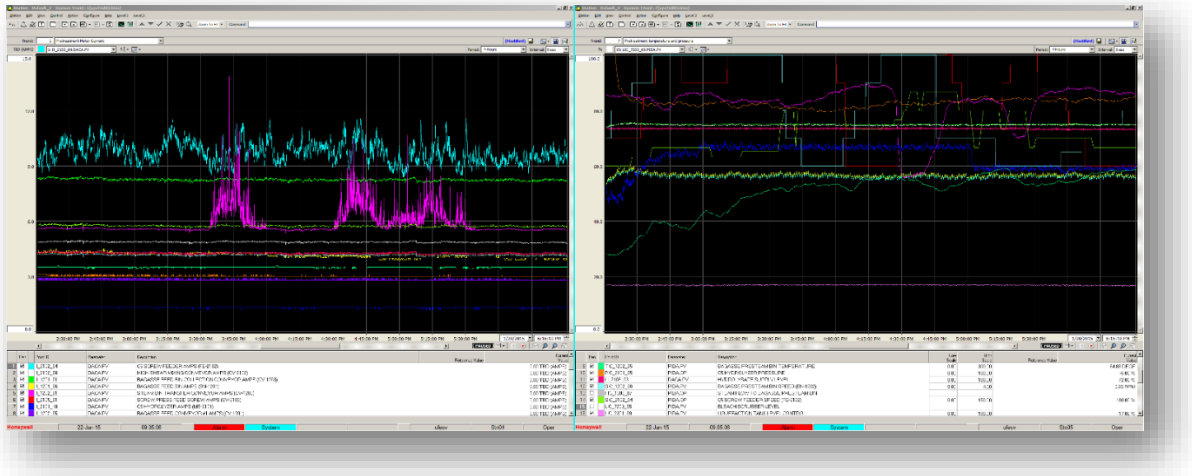
II. Pre-Steam Transfer Conveyor Chute

Problem

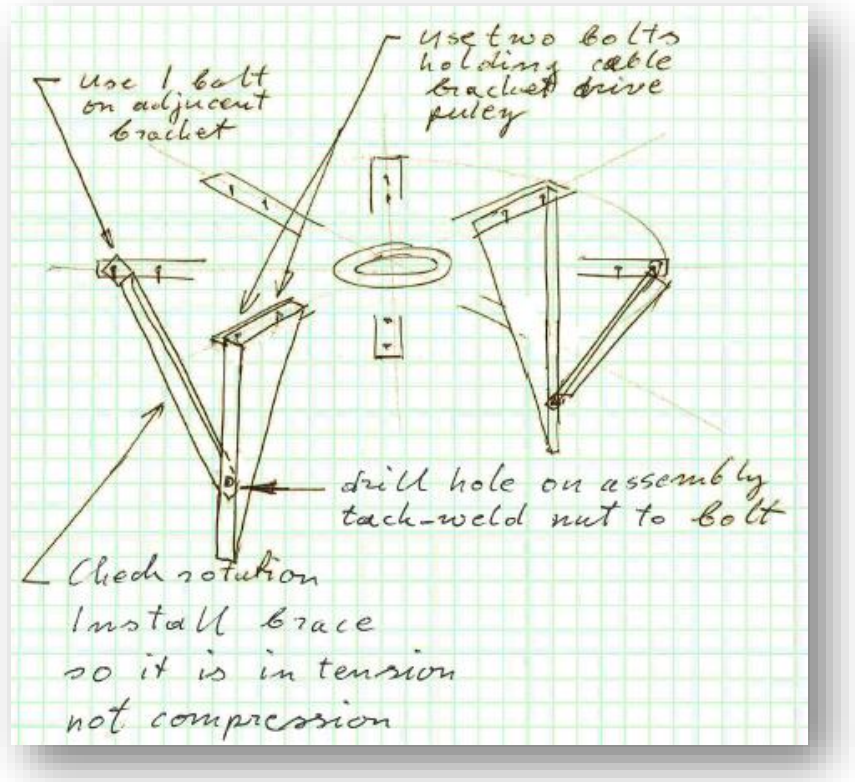
For an explanation of the problem, see the Campaign 6 Problems and Resolutions document. The 1/8" stainless steel chute and new VS-250 vibrator did not prevent chute clogging during Campaign 7.

Resolution

After close evaluation of trends, it was discovered that on some occasions of clogging, the pre-steam bin level suddenly dropped immediately prior to clogging. This led to the conclusion that level fluctuations in the pre-steam bin might cause biomass flow rate surging. The image below shows two trend screens which show amperages (left) and levels (right) at the same times. The pink spikes on the left correspond to the transfer conveyor amperage, and the pink line on the right corresponds to the pre-steam bin level. As can be seen, there is now level drop prior to the first instance of amperage spiking, but there is a significant level drop prior to the second instance of amperage spiking. It was decided that modifying the agitation in the pre-steam bin might prevent these sudden changes in level.



The original agitator consisted of two arms, see drawing below. After Campaign 7, it was decided to modify the agitator by installing a paddle between each arm. A live action camera was then installed to watch the inside of the bin during operation. If the paddle doesn't solve the problem, the camera will help us identify the problem during Campaign 8.



Original agitator.

An image of the modified agitator taken from the live action camera.

III. Distillation Heat Exchangers

Problem

The distillation system was finally tested with actual slurry broth during Campaign 7, but it did not go smoothly. Pre-heating the incoming beer is critical for an effective and efficient distillation process, and our system has three heat exchangers to accomplish this – a stillage, direct steam, and rectifier heat exchanger. All three of these require slurry (beer or stillage) to pass through very small orifices. These orifices cause clogging.

Resolution

Bypasses around the heat exchangers would allow operation to continue once the exchangers clogged. New heat exchangers need to be designed.

Status

The bypasses have been installed. The new heat exchangers have not been designed or installed.

IV. Contamination in the C5 Tank

Problem

It was discovered that hydrolysate from the C5 tank was slightly contaminated.

Resolution

The C5 tank was not designed to be sterilized (SIP) or cleaned (CIP), but it seems like both actions should be taken on a routine basis. Some easy modifications can be done to the tank to allow for both a CIP and gentle SIP process.

Status

The modifications are done, but official procedures have not yet been drafted.

V. Contamination in the Screw Press & Reversing Conveyor

Problem

It appears likely that stagnant biomass and hydrolysate in the screw press and reversing conveyor contains contaminates. Both the press and the conveyor were not designed to be sterilized (SIP) or cleaned (CIP). It was assumed that the hot temperatures from the pretreated biomass would disallow much contamination. However, with contamination evident in past campaigns, extra measures should be taken.

Resolution

If done in collaboration with the C5 tank, the screw press and reversing conveyor can undergo both a CIP and gentle SIP.

Status

The procedures have not yet been drafted.

VI. UV Water Pump Pressure

Problem

The UV Water pump pressure was found to be about 20 psi less than it should. This improper pressure will affect the CIP spray balls such that the CIP will not be ideal.

Resolution

The UV Water pump's regulator needed to be cleaned out. The pressure went back to normal afterwards. Add a new section to the Preventative Maintenance procedure which routinely checks the pressures of all main process pumps.

Status

Resolved.

VII. The Reversing Conveyor Gear Drive

Problem

A bearing in the reversing conveyor gear drive broke during Campaign 7. The temperature of the gear drive housing around the bearing was very high, but this was not discovered until we noticed an amperage increase in the conveyor. The gear drive manufacturer said it could have been avoided if the temperature was checked regularly.

Resolution

A new bearing was bought and installed. Add a section to the Preventative Maintenance procedure to routinely check the temperatures of the gear drives.

Status

Resolved.

VIII. Phosphoric Acid Addition Pump

Problem

The phosphoric acid addition pump for the pretreatment system stopped working. The oil appeared to be mixed with water, which led us to believe that the diaphragm ruptured. However, upon inspection, the diaphragm was found to be fine, but the plunger arm was missing. The plunger arm (part G) is needed to prevent oil from discharging through the bypass port while the diaphragm is pressurizing. It's essential for proper operation.

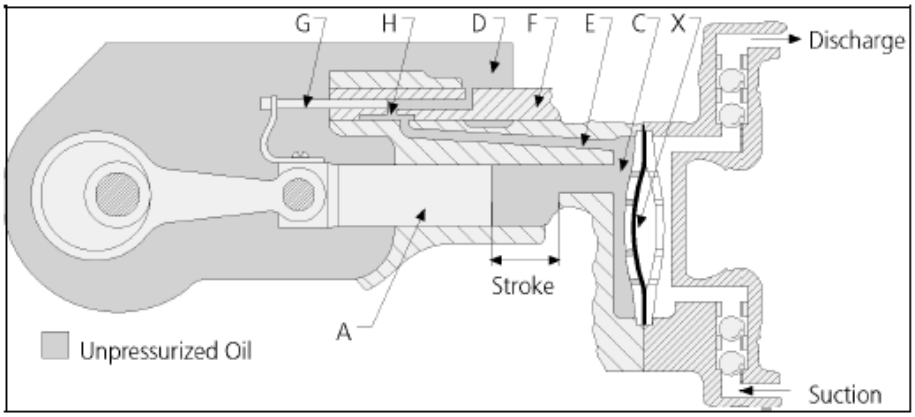


Figure 1. Pump Operation With By-Pass Port Open

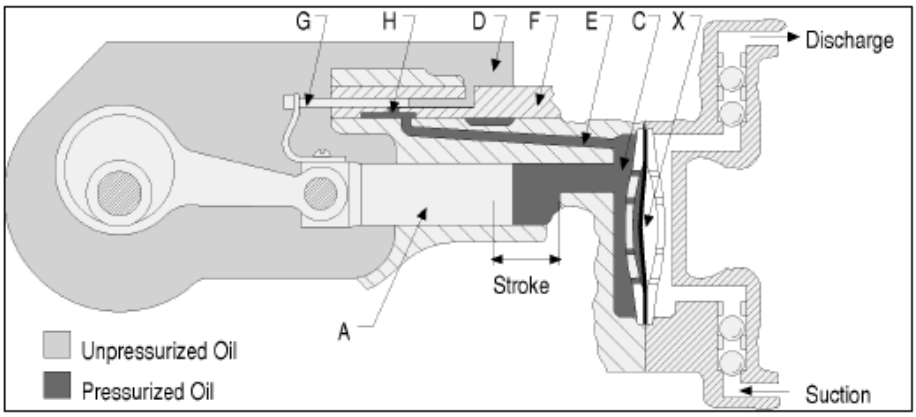


Figure 2. Pump Operation With By-Pass Port Closed

Resolution

Orders made:

- New BBD seals (made on 12/10/2014 – 6-to-8-week lead time (Danielle should confirm the lead time).
- Rebuild kit for our acid pump.
- New bearings and oil seal for reversing conveyor motor adapter kit (bought from Dennis from Miller Bearings)
- Vibco BVS 250 vibrator (190 was returned).
- A bunch of spare fittings to have in the plant.

Status

Not yet fixed.