# Campaign 6
# Problems & Resolutions

UF Stan Mayfield Biorefinery Pilot Plant

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**Campaign Date: November 2014**

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# I. Biochar Accumulation

## Problem

Prior to Campaign 6, after a run to squeeze hydrolysate, when shutting down metso, we cleared the plug screw like usual, but pieces of black charred biomass came out of the biomass dump chute (see picture below). These pieces might have been lodged in the biomass inlet port to the pretreatment system (immediately downstream of the plug screw), disallowing the dampner to close fully. The lodged biomass may have been the reason for the pressure loss we had been experiencing on startup during test trials leading up to the start of Campaign 6. We originally thought steam was leaking past the knife gates (biomass exit port from the pretreatment system), but there was no evidence, visually or from pressure trends, to indicate such.

Further explanation: The blow back dampner has a cone at the end of a shaft which seals the biomass inlet port to the pretreatment system. During pretreatment system start-up, this cone must be securely fitted into the biomass inlet port to allow for a pressure rise in the system. The biochar pieces might has disallowed for full closure, and thus a proper seal. Once biomass began to move through the system, pressure would begin to rise in the system, giving more proof that this theory might be correct.

Another area of biochar accumulation was discovered in the cylindrical chute between the hydrolyzer discharge screw and the top knife gate valve. Upon disassembly, it was found that a vast majority of the chute volume was taken up with solid biochar. It appeared like it had been accumulating for a while. We are concerned about what the hydrolyzer screw looks like. It is probably covered thick in biochar.

## Resolution

Ensure the biomass inlet port to the pretreatment system is always clear of biochar by confirming that the blow back dampner shuts fully upon system shut down.

A new section has been added to the “Preventative Maintenance” procedure to routinely clean the cylindrical chute between the hydrolyzer discharge screw and the top knife gate.

### Status
Resolved for now.

## II. Decanter

### Problem
Prior to Campaign 6, two of the main belts on the decanter broke while in operation. They broke because the bowl motor (the lower one) was not mounted perfectly horizontal. When the belts broke, they whipped around and damaged two speed sensors.

### Resolution
The positioning studs were adjusted such that it is now true and horizontal. New speed sensors were installed. It works great now.

### Money Spent
Belts and sensors.

### Status
Fixed.

## III. Pre-Steam Transfer Conveyor Chute

### Problem
We have had issues with the pre-steam transfer conveyor for quite some time. The chute would stack up with biomass and eventually bridge/clog, causing the plug screw to run free and the transfer conveyor to spike in amperage.

Prior to Campaign 6 it became the worst we had ever seen it. It was bad during Campaign 5, but not as bad it was prior to Campaign 6. Campaign 5, using bagasse batch 10023, we made it through the entire liquefaction without having to shut down because of the chute. However, while squeezing hydrolysate for the next Campaign we had a bad clog which caused us to shut down.

### Resolution
Progression of Modifications:

1. Prior to Campaign 6, we designed and fabricated a new chute which had no taper. It was a square, 1/16” 304 SS. The new chute design did not do the trick–it caused us to shut down.
2. We fabricated a new chute, with a taper starting at the very top, 1/16” 304 SS. It did not work.
3. We installed an airline to blast air upwards at the leading edge of the chute with hopes that it would break apart any bridging which may occur. It did not work.

4. We installed a vibrator (Global Manufacturing US19). The vibrator was installed incorrectly, but it worked well, until it cracked the chute. The chute metal thickness was only 1/16", and the vibrator was probably a little too powerful.

5. After Campaign 6 and before Campaign 6.5, we fabricated a new chute out ¼" 304 SS, and we installed the vibrator correctly. The US19 vibrator has a substantially lesser effect on vibrating the chute. We ran the vibrator at 80 psi (max) throughout the whole Campaign 6.5 and had several instances of almost clogging and once instance of actual clogging (at the very end of the campaign).
6. A technical rep from Vibco Co. stopped by the plant and let us trial two vibrators. We'll see how they work on 2014-11-19 when properly installed on a 1/16" chute.

## Money Spent

- Global Manufacturing US 19 Vibrator
    - Martin Vibrator purchased this because it's lower intensity than the US 19. It ended up being way too weak.
- An 8x4' sheet of 1/16" stainless steel
- A 2x4' sheet of 1/4" stainless steel

# IV. Dirty Steam Traps

## Problem

Most of the steam traps for our tanks are prone to clogging. If not cleaned out regularly there is a risk of contamination from pockets of old slurry. There are three steam traps per main tank, and most are quite difficult to get to. Two of the three have potential to meet media, one of which is far more likely.

## Resolution

A procedure which routinely cleans the traps.

## Status

Not fixed. We cleaned one of the three steam traps prior to Campaign 6.5 (the one most prone to contamination). We should routinely clean the other trap which has potential for contamination.

# V. Screw Press Coupling

## Problem

During Campaign 6.5, the screw press coupling lock ring popped off. This caused the screw press shaft to disconnect itself from the motor, which then caused the screw press screw to stop turning and clog.

## Resolution

Put back together. Include a procedure to check the coupling routinely.

## Status

Fixed for now.

# VI. Pretreatment Knife Gate

## Problem

Prior to Campaign 6, when trying to squeeze hydrolysate, we had trouble gaining pressure in Metso. We had to start feeding biomass early (around 70 psi versus usual 100 psi) to get things to act normally. It seemed like initially the bottom knife gate was leaking steam. The bottom valve was cleared out, but we still had issues. Upon inspection of the bottom knife gate, it looked like the tip of the gate may be worn down, which would mean it was not sealing completely when closed, which might indicate why we had steam leakage. Maybe once biomass started, it helped seal the small gap? Another possibility of pressure loss was through the plug screw. Maybe the charcoal discovered after cleaning was preventing the BBD to seal properly, and steam was leaking out on start-up?

One other possibility is wearing on the seat seals. This most likely the case. The manufacturer of the valves (trueline) said the seats must be replaced routinely.

## Resolution

We have not had as much trouble after this event. There are some random incidents of steam leakage though. For now, we are operational as is but will make sure it doesn't get any worse. We can adjust the

length of the knife, or we can always replace with our back-up knife-gate if it becomes really bad. We will install new seat seals regardless.

### Status

Resolved for now.

## VII. pH Adjustment Level Sensor

### Problem

The slurry inlet which was moved did not solve the problem. The level sensor still got splashed with slurry.

## VIII. Wastewater Pumping

### Problem

We have had trouble keeping the wastewater tank mixed, which has caused poor pumping and inaccurate pH readings.

### Resolution

Installation of recirculation loop.

### Money Spent

The parts needed for the loop.

### Status

Not resolved yet.

## IX. Feedbin Collection Conveyor

### Problem

During Campaign 6.5 it was discovered that the collection conveyor screw paddle developed a large lump of biomass. This may have contributed to some clogging and inconsistent feed. Upon examining a small sample of the large lump, it appears to be composed of fine biomass dust.

### Resolution
Chip off the lump.

### Status
Resolved.

## X. Squeezing Hydrolysate

### Problem
Prior to Campaign 6, we had trouble squeezing hydrolysate. We opened the screw press to find it very much clogged. We had never taken it apart to clean well since we started operation in 2012.

### Resolution
Opened the screw press and cleaned it well. Made a new procedure to clean the screw press ever so often.

### Status
Resolved.

## XI. Water Hardness

### Problem
Prior to Campaign 6, the hardness of the softened water was found to be slightly more hard than usual.

### Resolution

The drainage line for replenishing system was pinched off pretty good.

### Status

Resolved.

## XII. Propagator 2B Sparger

### Problem

Prior to Campaign 6.5, after sterilizing the propagator the sparger was clogged. Water had made its way in the whole line, including the flow meter. We had to take the check valve off and blast the air into the tank at a higher pressure to blow the water through the sparger. We used a sterile airline but non-sterile hose and fittings (the hose was clean and dry from the lab, we doused everything with ethanol).

### Resolution

We believe a CIP valve may be leaking, or the check valve did not work during SIP.

### Status

Not fixed.

## XIII. Propagator 2B Temp Control:

### Problem

A manual valve in the cooling water supply line for the propagator 2b was left closed. The reason was because the new Fermentor C condensing tower was installed without shutoff valves, and it ties into prop 2B. and 3A. cooling lines. The mistake was not discovered until well into the 24-hour propagation, but the cells grew well with only hot water cycling temp control.

### Resolution

Installation of shutoff valves for the Fermentor C condensing tower.

### Money Spent

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 47865K25 | Brass Ball Valve, 1" NPT Female Connections | 2 each | today | 21.44 each | 42.88 |
| 3 | 5182K838 | Type 316 Stainless Steel Yor-Lok Tube Fitting, Straight Adapter for 1" Tube OD X 1 NPT Male Pipe | 4 each | today | 53.69 each | 214.76 |
| 4 | 4429K145 | Low-Pressure Brass Threaded Pipe Fitting, 1 Pipe Size, Cap | 1 each | today | 10.32 each | 10.32 |
| 5 | 4429K255 | Low-Pressure Brass Threaded Pipe Fitting, 1 Pipe Size, Tee | 1 each | today | 20.50 each | 20.50 |
| 6 | 4830K221 | Standard-Wall Type 304/304L Stainless Steel Thread Pipe Nipple, 1 Pipe Size X 1-1/2" Length, Fully Threaded | 2 each | today | 3.61 each | 7.22 |

### Status

Not fixed yet.

# XIV. Autoclave Steam Filter

## Problem

A 60 psi O-ring on the steam filter out by the compressors failed.

## Resolution

Two new O-rings (minimum order).

## Money Spent:

The cost of the O-rings.

## Status

Not fixed.

# XV. Contamination in Pretreated Biomass

## Problem

Contamination was confirmed in the pretreated bagasse (185 C, 7.5 minutes, 0.8% phosphoric acid).

## Resolution

Increasing temperature, retention time, or acid might work.

## Status

Not fixed.

# XVI. Nutrient Addition

## Problem

The nutrient addition pumps do not work well. We cannot reliably pump into the fermentor. We tried new hosing, but we think the pressure which is needed to overcome the long lines, check valves, and slurry in the fermentor is too much.

## Resolution

Better pumps or a system to add nutrients via air. We will use small portable peristaltic pump if we need to–fittings are already made up.

## Status

Not fixed.