Campaign 9

Operations Summary

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Cellulosic Research and Demonstration Plant

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Operations – Campaign 9
02/09/2015 – 02/13/2015

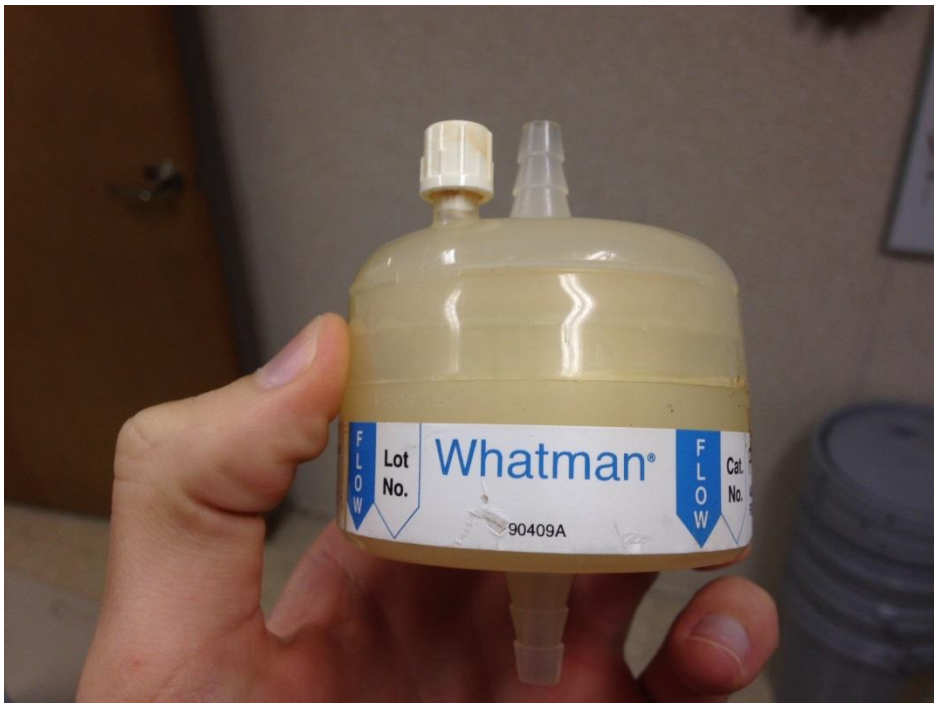
Experimental plan notes:

1. Propagation hydrolysate: 30% 190C
2. Pretreatment temperature: 190C
3. Liquefaction: 15% solids with 5% enzyme.
4. First campaign using the resurfaced ball valves. The knife gating leaking became too severe in previous campaign.
5. Second campaign trying the new experimental plan of conducting smaller scale fermentations in the propagator 3's, but with a different inoculation procedure than the first attempt.

Operation problems & resolutions:

1. No ethanol in either propagator 3
    a. Problem:
        i. The inoculation method was thought to be ideal, but the seed from the Propagator 2s wasn't very strong and the slurry appeared to be too toxic.
    b. Resolution:
        i. Perform experiments in the lab to figure out the correct concentration of nutrients needed for the 190C hydrolysate and slurry.
    c. Status:
        i. Not resolved. See subsequent operations summaries for further detail.
2. Pretreatment Blow Chamber Valve
    a. Problem:
        i. The top ball valve for the pretreatment blow chamber was opening and closing incredibly slow. It would take approximately 10-11 seconds to close whereas only 3-4 seconds to open. The actuator for the top ball valve was an ACTREG double actuated actuator. The bottom valve was opening and closing fine, taking 3-4 seconds to both open and close. The actuator for the bottom valve was the single acting Max-Air actuator (turned into a double-acting).
        ii. At the end of the campaign the top actuator completely stopped working. Turned out the diaphragm had ruptured, making the actuator useless. This is the second ACTREG actuator to fail on us. We were operating within the specified pressure range.
    b. Resolution:
        i. There was a piece of metal in the air hosing which was constricting flow and causing the actuator to close slowly.
        ii. There is nothing we can do to fix the ACTREG actuator, but fortunately, we had a spare Max-Air actuator.
    c. Status:
        i. Resolved.

3. Cleaning base addition dead leg
    a. <u>Problem:</u>
        i. While performing CIP on pH adjustment after we were done transferring slurry to the propagator 3's, one of our control room operators left the base addition pump running for approximately 20 minutes. The reason the base pump was on in the first place was because of a recent procedure change to purge the base addition line to clear any residual slurry in the dead leg pocket on the side of the tank. When we drained the tank the floor, the ammonia fumes were overwhelming and caused everyone on the plant floor to go inside for 15 minutes.
    b. <u>Resolution:</u>
        i. Better communication between the plant floor and the control room, and a better understanding of the procedure from our control room personnel.
    c. <u>Status:</u>
        i. Fixed.
4. Sterile filters for venting
    a. <u>Problem:</u>
        i. We had purchased several small, reusable sterile filters to see if they could be used for our propagation tanks. The idea was that we could use these instead of the bleach scrubber pump during the initial propagation stages of a campaign, and therefore overnight personnel would not be needed. Unfortunately, the moisture in the vented air slowly clogged the filters to the point where they vented too slowly.



b. Resolution:
    i. A resolution is not possible with the current filters, however, operations changed in subsequent campaigns such that night shift personnel is needed during the propagation stages.
c. Status:
    i. Not resolved, but acceptable.

5. Pretreatment acid line leak
    a. Problem:
        i. The fitting which attached the acid addition line into pretreatment started leaking steam and acid during this campaign. We could still maintain pressure in the system, but the leak was very noticeable and dangerous given that it was at the acid point of entry. There was some worry that the system's acid dosage was reduced due to solubilized acid in the escaping steam. We were unable to shut down the system to fix it while running. We believe the leak started due to vibrations from the vibrator on the pre-steam bin chute.
    b. Resolution:
        i. The fitting was welded and has not leaked since.
    c. Status:
        i. Resolved.
6. Loss of potable water
    a. Problem:
        i. Near the end of the campaign, the potable water tank ran dry due to a loss of feed water. This caused the pretreatment seal water pump to run dry, which then caused the system to shut down. Fortunately, we were far enough into the campaign that it didn't affect results.
    b. Resolution:
        i. Unfortunately, there is nothing that can be done. We lose potable water to the plant a few times every year.
    c. Status:
        i. Not resolved.
7. Inaccurate solids loading in liquefaction
    a. Problem:
        i. The dry weight of the liquefaction slurry was 17.5% once we hit our target 6 hour retention level. This value was too high. We set all parameters to give us a 15% dry weight, and we think the reason for the higher solids was an inaccurate level reading of UV water prior to start of liquefaction. The level of UV water we needed before we started liquefaction was at a point where our radar level sensor read somewhat inaccurately.
    b. Resolution:
        i. The dry weight was corrected shortly after we discovered it was too high, so the slurry used for fermentation was at the correct dry weight.

ii. It was decided that if the initial volume of UV water needed in the liquefaction tank falls within the unreliable level reading zone, the UV water addition flowmeter will be used to ensure the correct amount of water is added. Prior to this method, UV water was added quickly through a CIP line.

c. Status:
    i. Resolved.

8. Liquid in the vent lines
    a. Problem:
        i. Prior to sterilizing propagator 3B, a test was done to see if there was standing liquid in the vent line. Upon opening the vent valve into the tank there was indeed a stream of water which lasted about 5 seconds. The water is likely condensate, but it's not sterile and is a concern for contamination. All vent lines for the propagators and fermentors are tied together and are incapable of being easily cleaned or sterilized. In fact, they have never been cleaned or sterilized up to this point, which is why we emphasize keeping a positive air pressure in the tank. However, for some tanks, such as the propagator 3s and the fermentors, there is risk of stagnant liquid in the vent pouring into the vessel even with a positive pressure differential. This could have contributed to contamination issues in the past.
    b. Resolution:
        i. Prior to the start of a campaign we now make sure to dry out the vent very well, and then immediately prior to sterilization of a tank we open the vent to let any accumulated liquid fall into the tank. We also now look inside the tank when we open the vent after sterilization to ensure there is no liquid. Following these changes in procedure has seemed to help because we have not seen any liquid fall into the tanks and contamination has not been an issue.
        ii. We are still considering doing an annual CIP/SIP on the vent lines.
    c. Status:
        i. Resolved.
9. Propagator 3B spray ball
    a. Problem:
        i. One the CIP spray balls stopped spinning.
    b. Resolution:
        i. It had to be taken apart and thoroughly cleaned.
    c. Status:
        i. Resolved.
10. Loose bolts on pretreatment system
    a. Problem:
        i. The high pressure water seal pump's connecting bolts and nuts were found to be very loose after the campaign was over – the pump shakes while running so it was not surprising. This led to us checking other bolts on the system, and we found several spots near the vibrator where bolts were starting to back out.

b. Resolution:
    i. The preventative maintenance procedures were modified to include routine bolt tightness checks on the pretreatment system.
c. Status:
    i. Resolved.