Sedimentation Tank Hyraulics: Detailed Task List Fall 2012

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1 Objective 1 - September 13-20: Hindered Sedimentation Velocity Re-Test

- Note: Jill from STHT Spring'12 will show us how to use equipment in lab on September 11
- Re-test hindered sedimentation velocity test from STHT Spring'12 to confirm that upflow velocity is not equal to hindered sedimentation velocity and determine relationship between the two variables
  - Aim to form three distinct floc blankets under following experimental conditions: turbidity 100 NTU, alum dosing of 45 mg/L. The upflow velocity will be varied: 0.6/ mm/s, 1.2 mm/s, and 1.8 mm/s.
  - In each test, a floc blanket will be formed at a floc blanket height of 60 cm. Once floc blanket is formed, flow will be shut off for 10 seconds and a series of images will be taken at 0.05 second intervals
  - Each image will be subsequently analyzed to identify the position of the settling floc blanket over time. We will keep an eye out for any new information regarding characteristics of floc settling that may result from observations (we have a hypothesis that the flocs higher up in the floc bed have a slower settling velocity due to size, this would result in a gap in the settling of the floc blanket as heavier flocs on the bottom would settle faster than lighter flocs on top).
  - After these results are collected, an effective settling velocity will be measured by dividing the relative change in position of the floc blanket by time. Compare these results with the previous results from last year. The relationship determined will be useful for subsequent experiments conducted in the Floc Hopper.

2 Objective 2 - September 25-October 4: Floc Hopper Geometry

- Construct three floc hopper designs, each with a different plan view area: 10%, 15% and 20%. By varying the plan view of the floc hopper, we must also alter either the angle or volume of the hopper; we have decided to keep the angle constant and alter the volume.
- Install one of the hoppers and run the plant at 100 NTU, alum dosing of 45 mm/L and upflow velocity of 1.2 mm/s. These numbers may change, as long as they are consistent throughout the experiment.
- Measure how long it takes for flocs to fill up floc hopper. Then measure the concentration of flocs in the hopper compared to the concentration of flocs in the Sedimentation Tank.
- Once the flocs fill up the floc hopper, adjust the wasting rate until the rate of sludge leaving the hopper equals the rate of flocs entering the hopper (the optimal wasting rate). This can be estimated using a mass balance once the NTU values have been determined (since we also know the hindered sedimentation velocity from Objective 1).
- Record the data and reconduct the experiment using a different plan view size until all floc hoppers have been tested.
- Determine relationship between plan view and wasting rate and the relationship between plan view and concentration in hopper. The best plan view will be the one with highest concentration and lowest optimal wasting rate.

3 Objective 3 - October 11-25: Relationship Between Hindered Sed. Velocity and Solids Concentration

- With the information obtained in Objective 1, we now know how upflow velocity influences hindered sedimentation velocity. Therefore, by adjusting upflow velocity, we are effectively adjusting hindered sedimentation velocity AS LONG AS all conditions set during Objective 1 remain the same for this experiment. We will use one one of the floc hoppers that we constructed for Objective 2.
- Run the plant at turbidity 100 NTU, alum dosing of 45 mg/L. The upflow velocity will be varied: 0.6/ mm/s, 1.2 mm/s, and 1.8 mm/s while the sludge wasting rate will be the optimal rate as determined by Objective 2 (no height change of flocs in hopper).

- As the plant runs, measure the concentration of flocs inside the hopper for each upflow velocity (and in effect, the hindered sedimentation velocity).
- Record the data and determine a relationship between hindered sedimentation velocity and floc concentration in a hopper.

4 Objective 4 - November 1-15: Floc Blanket Failure Conditions and Detection

- Run the plant at turbidity 100 NTU, upflow velocity of 1.2 mm/s and optimal sludge wasting rate for chosen floc hopper. Start with an alum dosing of 45 mg/L.
- Every 10 minutes, decrease the alum dosage by 5 mg/L and observe the floc blanket until the floc blanket fails. Measure the effluent NTU as well (the effluent may be too contaminated to drink before the floc blanket fails).
- Run the plant again at the same conditions, this time increasing the alum dosage by 5 mg/L and observe until the plant fails. Measure effluent NTU.
- Analyze the videos of the floc blankets failing to determine any visual signals of imminent floc blanket failure.
- Time permitting, formulate an experiment to attempt to prevent floc blanket failure once signs are detected.

5 Objective 5 - November 20-30: Floc Blanket Stability

- Run the plant at varying input turbidities and flows. The floc hopper size and wasting rate will remain the same. We will test turbidities of 10 NTU, 100 NTU and 1000 NTU and test flows of 0.6/ mm/s, 1.2 mm/s, and 1.8 mm/s.
- Record the blanket formation time as well as the overall performance of the floc blanket for each test (measured by effluent NTU and visual observation), conducting each test for 10 hours.
- Analyze the data and draw hypothesis as to what directly influences Floc Blanket Stability.
- Write a guide for plant operators so they can understand the behavior of floc blankets as well as notice the signs of imminent floc blanket failure.