ety5

Ethan Yen's Individual Contributions

Fall 2012 Contributions

I worked on the Sedimentation Tank Hydraulics Team. Our main goal for the semester was to optimize floc hopper geometry as well as determine failure modes of the floc blanket to shed light on processes contributing to floc blanket stability.

Vertical Sedimentation Velocity

We started the semester by looking at the vertical sedimentation velocity. This velocity is controlled by the flow into the tank and effects how fast the particles settle. If this velocity is too high or too low, the sedimentation tank will not form a proper floc blanket. Since this experiment is a repeat of the hindered sedimentation velocity experiment from last semester, we read over that experiment in great detail. One of the conclusions made in that experiment was that the first 30 seconds was not long enough for finding the velocity because the computer program used to analyze the video was not sensitive enough to detect the small movement. We therefore looked at the sedimentation over a longer period of time.

From our data analysis, we concluded that selection of Region of Interest and Background images may cause large variance in the result of analysis. We arrived at the same conclusion as was described by the previous team.

Floc Hopper Geometry

We also looked into how the plan view area of the floc hopper would effect the floc blanket formation and performance. Changing the size of the floc hopper effects how much of the area allows for up-flow of the water and how much captures the flocs. In our experiment we tried different sizes at different wasting rates. We looked for a size and rate that keeps the plant running efficiently, meaning the least amount of water wasted while keeping the water leaving the plant clean.

We finished all experiments regarding different plan view area (10%, 15% and 20%) and different wasting rate (15ml/min, 25ml/min and 30ml/min). Since it took us several weeks to get all the experiments done, we changed some of the experiment conditions according to Dr. Weber-Shirk's suggestion and our own new understandings, for example the coagulant dose was changed from 45mg/L to 15mg/L to make the floc blanket denser, the geometry of floc hoppers are also slightly changed. For our most recent experiment, the plan view area of the floc hopper is 10%, with a coagulant dose of 15mg/L and up flow velocity of 1.2mm/s, we could get a floc blanket with the same height of our floc weir about 2 hours after we start the experiment and we could see flocs flowing into the floc hopper from the floc blanket.

Other Findings

1. We have to clean up the turbidity meter each time before we run the experiment, for clay residues settled in the turbidity meter may cause the reading of the turbidity meter to be higher than what it should be, therefore, it could cause the actual inflow NTU to be lower than the reading of turbidity meter which affects the formation of floc blanket.

2. We should clear up the clay residues settled in the tubes and tube conjunctions regularly. Since clay is likely to settle down in the tubes, especially tube conjunctions when we have our apparatus stopped, it may add more head loss to our whole system. Therefore we need to decrease the inflow flow rate and the up flow velocity which inhibits the floc blanket going up.

3. A good way to measure high NTU is to dilute the sample before measuring.

Continuous Wasting of Flocs

One of the ideas we worked on was continuous wasting of the flocs. The idea behind this is to allow for constant removal of flocs instead of collecting the flocs and then manually opening a valve to let them leave the tank. When the wasting rate is optimal, the flocs will be allowed to compact before they are removed so that the least amount of water is lost in the process. Our experiment looked at finding the proper wasting rate where the rate of particles flowing into the floc hopper was the same as the rate at which the particles were being removed. In continuous wasting, sludge is continuously removed from the floc hopper. Since they are being continuously removed, the flocs are not given as much time to settle as in pulse wasting. Therefore suspended flocs were being removed instead of consolidated sludge. To minimize the wasting of clean water, the wasting rate should equal the rate at which flocs are flowing over the weir. This wasting rate is also a function of the influent rate and influent turbidity as well as the concentration of flocs in the floc blanket. The previous team discovered that the overall problem with continuous wasting is that a high wasting rate will leave little time for flocs to condense and the waste pump will be drawing out clean water that could have been used for drinking. However, a low wasting rate can cause a floc blanket failure where flocs flow up into the tube settlers and eventually into the effluent. Therefore in our experiment testing different weir sizes, it was important to find a balance where minimal water was being wasted and there was a high concentration of flocs in the weir, but not to the point where the floc blanket was in failure.

The results of the constant wasting rate experiment suggest that the floc hopper does help make flocs denser but it might be difficult to keep flocs from settling down in the wasting tube when the constant wasting rate is relatively low. Therefore, we may have to wash the wasting tube frequently to prevent flocs settling down in the wasting tube. This experiment suggests that there must be some optimal wasting rate that exists in a range that previous teams have not considered (somewhere between 1.5mL/min and 2.0mL/min).