Floc Hopper

June 13, 2011

Abstract

We have evidence that floc blankets are forming in the sedimentation tanks at Marcala, Honduras. The floc blankets grow too deep and flocs begin to rise through the plate settlers. We need a method to control the height of the floc blankets. The proposed solution is a floc hopper at the drain end of the sedimentation tank. The floc hopper has two functions. It sets the depth of the floc blanket in the sedimentation tank and it consolidates the flocs prior to wasting with the floc hopper valve. Floc consolidation is important because this reduces the volume of water that is wasted. The design of the AguaClara sedimentation tank must be revised to incorporate a floc weir.

students 2 FT (This is a design team)

1 Introduction

The floc hopper (see Figure 1) must be placed at the end of the sedimentation tank that is closest to the drain channel so the floc hopper drain can also discharge into the drain channel. The floc hopper design choices are:

1. Z.SedFlochopperWeir - The height of the top of the floc hopper weir that will then set the depth of the floc blanket. It is probably best if the floc blanket doesn't reach the bottom of the plate settlers and thus we may want to set the top of the floc hopper weir to be approximately 10 cm below the bottom of the plate settlers.

2. AN.SedFlochopper - The angle of the floc hopper could be 60º or perhaps as low as 45º. The goal is to be able to have the sludge slide down the incline easily. It may be best to make this 60º to reduce the risk that sludge will accumulate and not slide into the drain.

3. ND.SedFlochopperValve - Ten state standards suggests that the minimum diameter for any sludge valve should be 3 inches. That seems rather large given what this valve has to handle. I believe we have used 2 inch valves on sedimentation tanks and they performed well. The flow rate for this valve will be very low. We should estimate the sludge flow rate. My intuition is

that the valve should be at least 1 inch in diameter so that it won't clog too easily. In normal operation the plant operator may leave the valve open slightly with a low continuous flow rate discharging the sludge as it accumulates and consolidates in the floc hopper.

4. L.SedFlochopper - distance between the drain end wall of the sedimentation tank and the floc hopper weir. This would be estimated based on the floc hopper plan view area required to consolidate the flocs.

The plan view area required for floc consolidation is not yet known (by AguaClara...). The sedimentation tank hydraulics research team will be investigating this parameter using laboratory experiments. The consolidation process is sufficiently complex that this may not be an easy parameter to obtain by modeling. The best approach may be to build a floc hopper either in the plate settler spacing apparatus or in Matt Hurst's sedimentation tank slice. The required area will be proportional to the floc blanket production rate.

It is important that the design be checked to ensure that it is constructable and that a human can clean out the floc hopper from inside the sedimentation tank if necessary.

The sedimentation tank design parameter V.UpBod should probably be increased to closer to 1 mm/s and then the effective area of the bottom of the sedimentation tank should NOT include the area designated for the floc hopper. This will require modification of the sedimentation tank design algorithm.

The maximum distance between the drain end wall of the sedimentation tank and the floc hopper weir is the distance to the first plate settler. This space up to the first plate settler is currently poorly utilized and thus could easily all be used by the floc hopper. If the floc hopper length causes the angle of the floc hopper to become too shallow, then the floc hopper could have a bottom that slopes in all four directions.

The double bottom slope (see Figure 2) is used to extend the length of the floc hopper without using a bottom slope that is too shallow.

There may be other geometries for the design of the floc hopper. For example, the floc hopper weir could be a thin vertical wall made from removable ferrocement "boards". The bottom slope could be longest on the drain wall end of the floc hopper.

The two drain valves (sedimentation tank drain and floc hopper drain) need to be positioned so that both are easy to use. They can't be aligned vertically because we may want to have valve control rods extending through the platform to each of these valves. Thus the valves must be offset.

It would be great if the operator could see the depth of sludge in the floc hopper and the depth of the floc blanket in the bottom of the sedimentation tank. A submersible LED could be lowered into the sedimentation tank and the depth of light extinction could be used to estimate the location of the top of the sludge in the floc hopper. It may be possible to cut out a small opening in the first plate settler to provide a space to lower a light into the floc hopper.

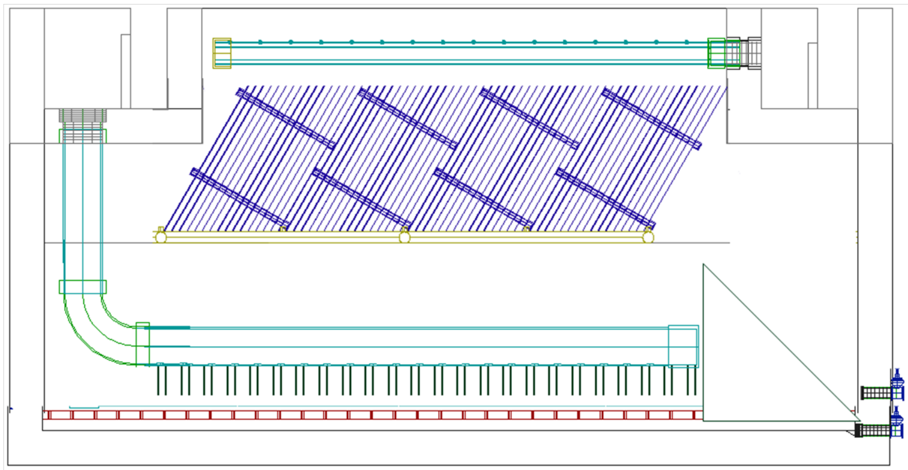

Figure 1: Preliminary sketch of a floc hopper with a bottom sloping to the drain end wall.

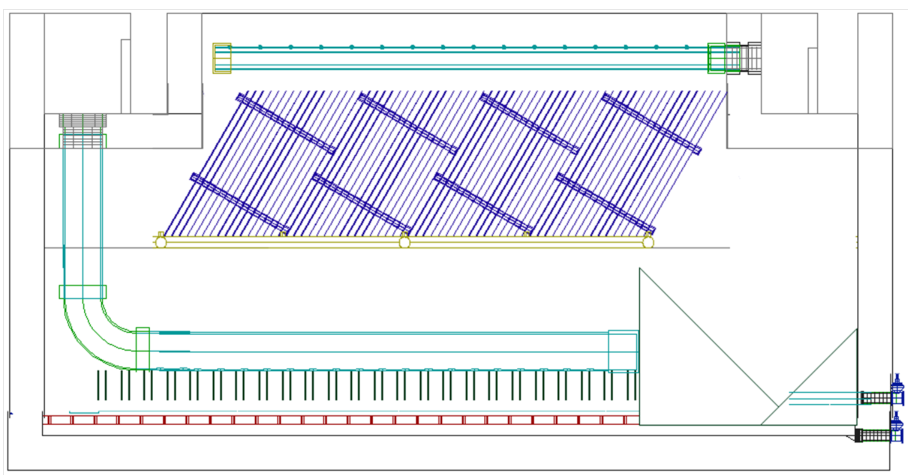

Figure 2: Preliminary sketch of a floc hopper with a double bottom slope.

2 L.SedFlochopper considerations

The plan view area and time required for floc consolidation is not easily estimated. The fractal flocculation model predicts that at 1000 NTU the floc volume fraction is 0.16. Thus the flow over the weir would be $0.16Q_{SedBay}$. Does this mean that the area of the floc hopper should be about 16% of the sedimentation tank area? We need some modeling work here to understand what controls this consolidation process. A literature review would be useful and experimental work may be needed.