Case Study Service Report

2010

Treatability Analysis Conducted By:

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General Manager
Summary:

For this last visit the following items were covered:

1. System Jar Testing: a sample of the untreated waste water being fed into your waste treatment system determined that no additional coagulant product was needed for quality treatment. With just the addition of the precipitant, all of the metals were precipitated with crystal clear water and great flocc formation. These results further illustrated the need for your folks to do one or two simple jar tests a day to determine the chemical demand for the day. Today you were unnecessarily feeding lots coagulant.

2. Waste Treatment System Inspection: A sample pulled from the tank right before the clarifier settled out to a messy cone shape indicating a large excess of polymer feed. It is believed that the recycle of this excess polymer was causing coagulation problem that the operator thought would be fixed with extra coag when it was more than likely too much polymer feed. A simple jar test once or twice a day coupled with a little more training will help to solve this issue.

3. Sand Filter: the final quote for the 45micron sand filter was issued and we are waiting on PO and installation date.

4. Sludge Dryer: To run or not to run that is the issue: A properly functioning waste treatment system using the ISS technology can put out a filter cake that ranges between 65 and 75% solids. The sludge dryer will take it up to between 75 and 85% solids. It is estimated that the sludge dryer could cost anywhere from $35 to $55 per 8 hour day to operate. Assume 4,280 lb bags of 7% solids = 2,800 lbs of water. If we dry to 85% then we now have 1,680 lbs of water. We dry off 1,120 lbs of water. Depending on how wet the sludge costs us that water reduction costs us anywhere from 700 - 1,100 / month in operating costs for the dryer. This does not take into account the up keep costs of the dryer itself. It is my opinion that we focus on making dry filter cakes and turn the dryer off.

Jar Testing and System Inspection Results:

The onsite jar testing coupled with the system inspection on this trip visit further illustrated the need for your operators to conduct a simple jar test once or twice per day to determine the systems operability and chemical requirements. Over the past 4 or 5 visits
we have conducted jar tests that indicate a good 40 to 50% of the time the addition of the coagulant that we are formulating for you will give much better performance than the current coagulant that we have on line. As it turns out, the other part of the time no coagulant is required at all.

Today's system inspection revealed that way too much of the flocculent was being added to the system. This was indicated by a 1000ml grab sample being pulled from the flocc tank, right before the clarifier, and watching the flocc bed as it settles out in the jar.

![Figure 1: Cone and Flat Bed Settling](image)

The jar on the left represents settling behavior that is indicative of flocculant overdose. The jar on the right represents proper settling.

Due to your processes and lack of equalization, your system must be monitored more closely than others. Managing waste flows into the waste treatment system by scheduling dumps and the like will present a much more consistent waste water to the treatment system and thus allowing a consistent program to be applied; "set it and forget it" if you like.

Unfortunately, we are not there yet, so we either have to pay to over treat or get the operators to monitor the system more closely using simple jar testing techniques in order to determine the chemical demands of the day.

Jar testing procedures will be reviewed on Wednesday's visit and will reinforce at every visit.
Clarifier and Solids Management Training:

During this visit we conducted a simple training class where we discussed the basic functioning of the clarifier and proper solids management techniques and their importance. The following is a review of that discussion.

The discussion started with a hand sketch of a standard metals recovery system. I have included a more formal flow sheet that includes all process elements involved. The system presented above is very similar to yours, minus the large equalization tank. You guys have a tank string, back end sand filtration and holding system. You guys are headed that way with the purchase of a sand filter. The other difference is you guys also run a coag and a MR-400 additive to your ISS-833. Other than that, the systems are similar but you should always be working towards getting your system to contain the elements as the above.
The next portion of the discussion we took a look at a clarifier running at steady state:

In a clarifier operating at steady state, all inputs into the clarifier equal all the outputs. The amount of water entering into the clarifier equals that leaving. The amount of solids entering into the clarifier equals the amount exiting.

The solids distribution within the clarifier is such that the solids are falling to the bottom quicker than they can be carried with the water flow out of the top. The very top layer of the solids bed is perfectly clear and solids free, this is the water that flows over the discharge weir. The solids concentration gets greater and greater as we get closer to the bottom of the clarifier where the solids concentration is what we called thick solids. The solids are pumped out of the clarifier at a continuous rate into the solids thickener.

If the solids are not pumped out as quickly as they are input to the clarifier, solids will start to accumulate in the bottom. Solids input
no longer equals solids output and thus we then have an unsteady state clarifier.

Here, solids are not removed quickly enough. They have to have some place to go because they are still coming in. They start to fill up the bottom chamber in the clarifier and thus push the entire sludge bed up the clarifier. This causes the turbid layer of pin flocc to rise up and start to exit the weir.

It is very important to insure that the solids are being removed from the clarifier at a consistent rate. This means that the solids are continuously pumped from the clarifier to the solids thickener where the solids are pumped from the thickener to the press. All these pumps must be pulling solids at the same rate or the solids will start to accumulate in the clarifier or the solids thickener. Steady state is what we are looking for.

Most folks have their sludge pump taking solids from the bottom of the clarifier attached to a simple timer. This allows the operator to increase or decrease the solids draw off frequency.
The other side of the issue comes into play when we are initially starting the clarifier up or we are operating the clarifier with too few solids.

When we shut down the clarifier at the end of a shift all of the solids settle out to the bottom. When we turn the clarifier on again at a later time, the force of the water rushing through can sometime kick up the solids into the upper chamber of the unit. This problem is usually temporary unless you have a "rat holing" or "short circuit" issue. We will get into those issues in later discussions. When this happens simply direct the output clarifier flow back to the head of the plant and recycle until the problem settles down. This should take 20 or so minutes at the most.

Clarifiers like to have some amount of solids in the system. As a rule of thumb a 1000ml sample should contain a solids bed that settles out to the 15 - 25% level or 150 - 250 ml level one a 1000ml beaker. If you find that you are running solids weak, just increase the flow rate of your solids recycle from the thickener until you see the level rise to the desired level.
The not enough solids can cause the entire clarifier to get "churned up". The solids bed in the bottom of the clarifier actually helps to slow down the particles in the fluid stream so that they do not flow right out with the water; if these solids are not present, particulate over the weir can be an issue.

There is another reason that we want to maintain a certain solids level in our system: coagulation and flocculation. The processes of coagulation and flocculation have efficiencies that are very strongly dependant on particle collisions or particles bumping into one another. We have found that systems that run between 15 - 25% settled solids in the 1000ml beaker run the best. There are just enough solids so that enough particles are present so that the right amount of "bumping" occurs and not too many, such that the party gets a little too crowded.

The next slide presents a few ideas on simple automation that can help. Pay special attention to the pH issue. We want to run the pH of the system such that it allows for the maximum insolubility of copper hydroxide. I have also attached a separate phase diagram for copper hydroxide that I will discuss at the next visit.
1. **Insures Maximum Equalization:**
   A simple low float, high float level control on a properly designed equalization system will ensure that optimized equalization is constantly maintained. A major cause for system upsets is when incoming flow is pumped through the system from an empty equalization basin.

2. **Perfect pH Control: Not An Option For Program Success**
   Most plating shops deal with the removal of several different metals in the same system. Most metal hydroxides do not fall out at the same pH. If precise pH control is not maintained then metals that could normally be removed with simple and inexpensive hydroxide precipitation will require excesses of additional chemical precipitant to remove.

3. **Simple Timers and Switches Enable Our Clarifier To Run Trouble Free More of the Time:**
   Simple timers fixed to our solids draw off pump from the clarifier and the filter press pump pumping solids from the sludge thinker to the filter press enable our solids wasting system to function properly with very little interface with the operator.

If you have any questions or concerns, please do not hesitate to give me a call.

Scott Bowers
Sincerely,

Scott Bowers
GM

Southern Water Treatment, Inc.