jhl95

Jae's Individual Contribution Page

Spring 2011

As the leader of the stock tank mixing team, I was responsible with thinking about different mixing design systems, organizing and leading the experiments in bench scale, and analyzing this information in order to implement these designs to full scale in the current plants in Honduras. We experimented initially with alum and in the middle of the semester changed to PACl. Therefore, we were able to create experimental designs for both coagulants.

Over the first two weeks of the semester, we started with researching about the properties of alum and finding feasible mixing designs to completely mix the system. At first, I did not realize that the mixing process was divided into two steps: dissolution and homogeneous mixing. At that time we solely focused on dissolution. We experimented with filters and considered implementing static mixers to mix the solution and we took occasional trips to Home Depot to buy pipes, fittings, and filters to experiment.

The probably most important difference between alum and PACl in the point of view of stock tank mixing, is their dissolution rate; the alum takes a while to dissolve and therefore we have to design in order to implement dissolution into our experiments. The first two experiments below were done with alum coagulant and we only worried about dissolution (and not homogeneous concentration mixing).

Our first experiment was the "double bucket" design; the design was originally taken from Surface Water Treatment for Communities in Developing Countries by C. R. Schulz and D. A. Okun (Reflection Report 1). We also experimented with "moist" alum, which, in this state, is very hard to dissolve. In order to prevent this state of alum, the double bucket design always had the alum submerged. One of the assumptions we was once the alum particle becomes small enough to flow through the filter, it will be considered "dissolved" alum. However, we soon found that the filter gets clogged more consistently than not and we concluded that filters in these experiments were unreliable.

After the "double bucket" experiment, we conducted the upflow experiments, which involved mixing the alum solution through vertical up flow. This gives the advantage of the up flow water being more into contact with the granular alum and its dissolution rate.

In the middle of experimentation, we found out that PACl was less dense than water. Meaning, the PACl will simply likely float on top of the alum than sink like alum. However, we later realized the PACl dissolution rate was not a very big issue. With the small PACl we have at the lab and email conversations with Mr. Antonio Elvir (AguaClara technician in Honduras) we decided to tackle the nonhomogenous concentration gradient formed in the solution. Also, since we didn't have much PACl left, we bought a sack of pool salt from Walmart (see Final Report) and used it to experiment with concentration gradients.

When dealing with homogeneous mixing, it is important to remember that the solution truly becomes homogeneous when molecular diffusion occurs. If not, the solution will simply settle back to reform a concentration gradient in the tank.

Our first experiment with PACl was pouring (or "dumping") water on top of the concentrated solution. Ideally, the energy of dumping the water on top of it will create a high enough energy dissipation rate to enable the particles (or solution molecules) to complete homogeneous molecular diffusion. We discovered that this method was not enough to finish molecular diffusion and it was a bit impractical to use this in Honduras.

Then, we tested the simple stirrer, or the stick method. Intuitively, this is done by inserting a stick in the tank and stirring it in a circular motion while sticking to the inner circumference of the tank. Using a Lowe's 5 gallon bucket scale, we had to stir 120 times to reach the final density and only yielded a 1.2% efficiency. We believe this was mostly because this method only implemented horizontal mixing and therefore, a lot of wasted energy.

The centrifugal pump is supposed to do what the stick mixer does worst: vertical mixing. The concept of the centrifugal pump is to bring the water from the bottom concentrated layer onto the top forcing the two layers to interact. We only did preliminary testing on this mixing system and is theoretically valid but we are not yet certain if it is viable in experimentation.

One of the things that I wish we could have done is be able to experiment using the process controller using the real data. I hope the next Stock Tank Mixing team will be able to do this because I'm sure there will many, many interesting discoveries with this data.

It is hard to say which experiments were my own singular contributions. On this team, especially since this a new invent team, I feel that everyone has contributed on every design, experiment, and code that we've put together in every degree. I feel really lucky to have ended up with excellent team members and I hope that the discoveries and contributions made of the current Stock Tank Mixing team will help the future to use these to discover many more exciting things.

Summer 2010

I helped run some clay experiments and learned how to use the process controller and the lab bench-scale setup. I also helped troubleshoot some mechanical errors in the lab system.

Fall 2010

This semester, I ran some clay experiments and I analyzed the calculations need for the aluminum tube high velocity gradient experiments.