Dashboard / … / Plate Settler Spacing

PSS Fall 2009 Experiments with Saturated Water

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Experiments Using Influent Water Saturated with Air

This experiment explored the impact of water supersaturated with respect to atmospheric pressure on floc blanket formation and performance. This experiment involved collaboration with the Floating Floc Research Team, who supplied the saturated water that served as the influent water to the process.

Introduction
Our team ran an experiment to investigate the affects of saturated air on floc blanket formation. To do this, our team paired with the Floating Floc research team, who supplied water saturated with air to the process. This experiment is meant to model the effects of having a supersaturated system i.e. the effects that change in pressure in the transmission line to the plant could have on sedimentation performance due to dissolved gas coming out of solution in the influent water as bubbles.

The idea for this experiment is derived from the need to model the affects of altitude change on an actual AguaClara treatment plant. Elevation changes can cause pressure changes in pipe, and as pressure increases, the concentration of dissolved gas water can hold increases. At higher pressures, water can have higher concentrations of dissolved gas. When the pressure is normalized to atmospheric pressure, these dissolved gasses can come out of solution in the form of air bubbles.

Procedures/Overview of Methods

In order to deliver influent saturated air to the process, the Floating Floc Research Team created a system which pressurized the influent water to a pressure greater than atmospheric pressure. At double atmospheric pressure, the amount of air dissolved into the water is approximately twice the amount of air dissolved in the water at atmospheric pressure.

This supersaturated water was fed to the apparatus as influent water, where it immediately experienced a pressure drop to atmospheric pressure. While a pressure drop should result in the immediate formation of escaping air bubbles in the liquid, these did not form immediately. This is due to the activation energy required for the bubble to form, which is dependent on the surface tension of the bubble. In order to test bubble formation we observed the experiment qualitatively, looking for bubbles throughout the apparatus. We also monitored effluent turbidity, a parameter that would reflect the effect of the bubbles on tube settler performance.

Results

The hypothesis that absorbed air would be released in the apparatus was qualitatively observed by bubble formation. The adverse effects of bubble formation on floc blanket formation and effluent turbidity were supported qualitatively by the cloudiness of the liquid exiting the sedimentation tank through the tube settler. It is possible that these air bubbles broke up larger flocs resulting in smaller floc particles than expected. The velocity gradient controls the transport of flocs that enter the tube settler to the effluent for turbidity measurement. Floc roll-up is characterized based on a force balance. Due to the fact that smaller floc particles are entering the velocity gradient in the tube settler, the foce balance reveals that these particles are more likely to escape into the effluent, increasing effluent turbidity.

Quantitatively, data collected over twenty four hours showed an increase in effluent turbidity when comparing the experimental run with saturated air to the control experiment. We ran this experiment on both high and low floc blanket levels. In the high floc blanket formation state the floc blanket level is above the plate settlers. In the low floc blanket formation the floc blanket formation level is below the plate settlers. The presence of air bubbles could break up some floc particles and force floc particles up into the clarified effluent.

Experiment 1 & 2: Low & High Floc Blanket Formations

Conclusion and Future Considerations

It was expected that the release of saturated air as bubbles in the sedementation column would prevent effective floc blanket formation. The bubbles were expected to break up larger flocs and, create smaller, lighter flocs that would leave through the plate settler (due to a force balance velocity gradient analysis) and increase overall effluent turbidity. An increase in effluent turbidity and the appearance of bubbles in the apparatus supported this hypothesis in the experiment on low floc blanket formation. However, for the experiment on high floc blanket formation, the data was not consistent with this prediction. If AguaClara is considering designing additional plants undergoing elevation drops, results from this experiment should be considered.

Future experiments relating to saturated water in the plant could include bubble removal before floc blanket formation. However, the true effects of saturated air on the experiment cannot be fully determined until the hydraulic jump produced by the current design of AguaClara linear chemical doser system is ameliorated. It is not well understood whether bubbles created from the falling jets are the potential cause of worsened performance in plate settler effluent or if worsened performance is caused more by the presence of supersaturated air in some plants, or if both are causing worsened performance.

No labels

1 Comment

Monroe Weber-Shirk

Water treatment plants don't "traverse altitude drops and climbs". I think you mean if the transmission line has significant drop in elevation. APP has already built AguaClara plants that have those characteristics.