Dissolved Air Flotation of Flocs

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Overview

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Floating flocs in the sedimentation tanks of AguaClara plants in Tamara, Ojojona, and Marcala result in polluted effluent water. While some treatment plants use floating floc to treat water, AguaClara plants rely on flocs settling out at the bottom. The floating flocs problem is thought to stem from supersaturation of influent water, which occurs when the dissolved gas pressure is greater than the local solution pressure. Because the water is supersaturated, gas bubbles naturally tend to form in order to bring the dissolved gas concentration in the water to equilibrium with the surrounding pressure. The cause floating flocs problem is thought to be bubbles forming on or attaching to flocs, lifting them to the surface.

The Dissolved Air Flotation of Flocs Team (DAFF or Floating Flocs) has been focusing on lowering the bubble forming potential of the water entering the sedimentation tank. The team was working with a backwashed sand filter using this experimental setup. We believed that providing sand as an alternative surface on which bubbles can form and rise out of the water would stop the floating flocs problem; however, research has shown that the sand used did not aid but rather inhibited gas removal. Literature regarding bubble formation, which can be found in the Floating Floc Annotated Bibliography, indicate that rough, hydrophobic surfaces are most conducive to bubble formation. The shortcoming of the fluidized sand bed method is believed to be due to the sand particles' lack of hydrophobicity.

The team's future plans include studying the effects of hydrophobic surfaces and surfactants on surface tension and bubble formation, while trying to develop a new solution to the floating floc problem. The team has been focusing on gas removal mechanisms; however, in light of the recent failure of the sand filter method, the team will also focus on possibly developing a method to stop flocs themselves from reaching the surface. Any approach developed for stopping flocs would be constrained by preventing floc break up. The team's tentative plan for future research can be found on the Floating Flocs Team's Future Challenges page.

Objective

The main objective of Dissolved Air Floating Flocs Team is to develop a physically feasible and cost-effective solution to the problem of floating flocs at AguaClara plants. The team was previously working with a backwash sand filter. However, research has shown that sand does not facilitate, but rather inhibits, bubble formation. The team plans to focus on developing a method to either remove gas from supersaturated water or stop flocs from floating to the surface even in the presence of bubbles.

Floating Flocs Team Semester Goals and Meeting Minutes
Floating Flocs Team Research Proposal
Floating Flocs Team Future Challenges

Previous Research

Previous Fluidized Bed Method Research: Links are separated by adaptations made to the system

- Final Results from the Fluidized Bed Method
  This page contains experimental results from the final stage of the sand filter set up. It was concluded that the sand filter would not provide a suitable mechanism for gas removal, because experimental results suggest that sand seems to inhibit rather than facilitate gas removal. The main modification made to the set up from last semester was the installment of a taller pressurized aerator to increase the residence time of the bubbles in an attempt to achieve more consistent supersaturation of the influent water into the sand filter. A more detailed description of changes made to the system along with a diagram of the current setup can be viewed here.

- Fluidized Bed after Super Saturator
  This page contains experimental results for gas removal as a function of grain size and preliminary results for gas removal as a function of sand bed depth. These are the results obtained using a pressurized aerator to super saturate the incoming water. The performance of the fluidized bed was monitored with a bubble collector. Although this technique shows great promise, the extent of supersaturation of the raw water was not necessarily held constant for the various experiments especially since the flow rates through the aerator varied.

- Bubble Volume Measurement Method Development.
  These are the results gained from the second stage of our experimental setup, which included no DO probes and instead collected the volume of the bubbles formed in the filter in order to monitor oxygen removal rates.

- Fluidized Bed and Dissolved Oxygen Measurements.
  These are the results gained from our initial experimental setup, which consisted of the flow accumulator with a DO probe, the glass filter column, and a collection beaker containing another DO probe.

Previous Aeration Method Research:

- Floating Flocs Aeration Method
  This page discusses past research on the aeration approach to dissolved oxygen removal. The aeration approach attempted to use bubbles as a catalyst to increase the rate of dissolved oxygen transfer out of solution by allowing dissolved oxygen to diffuse into the bubbles. This would increase the bubble size and cause the bubble to rise faster.

- Theoretical Modeling of Aeration Method
  This page discusses the theory behind the Aeration method and contains mathematical models predicting air flow through orifices of different sizes and variable length pipes.

Additional Information

Floating Flocs Team Annotated Bibliography

Aeration Method Quiz
This quiz checks that you have a basic understanding of the principles behind the aeration method.