# Algae Settling in Logan Lagoons Wastewater for Secondary Clarifier Design

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## Abstract and Objectives

The Logan Lagoons, Logan City's Wastewater Treatment Facility, treats 15 million gallons of wastewater each day. Regulatory changes are forcing the city to upgrade the facility to reduce the phosphorus concentration in the effluent. Algae have been proven to be effective at removing phosphorus and nitrogen from wastewater while simultaneously contributing feedstock for biofuel production. One major drawback is the energy expenditure of the harvesting process. This is related to algae having a negative surface charge causing particles to repel each other and remain in suspension, this is atypical of colloidal particle behavior. The algae used in the testing are a mixed culture from the Logan Lagoons effluent stream and are grown in 50 liter micro-raceways indoors.

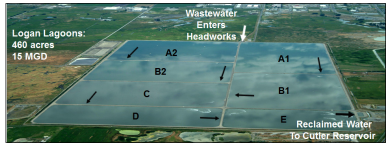



**Figure 1. Logan City Lagoons Wastewater Treatment Facility**

The objective of this project was to study the potential for using a secondary clarifier to remove a large fraction of the algae prior to using an energy intensive method. Clarifiers, common in wastewater treatment, use gravity as the mechanism for the separation of solids from solution. This produces clarified water and a thickened solids fraction, which can be used as a feed stock for biofuel production. In order for sedimentation to be effective algae must develop a more neutral zeta potential or surface charge. This can be accomplished though the mechanisms of auto, bio, and chemically induced flocculation. Flocculation is the clumping of particles called flocs. Sedimentation columns and jar tests were used to identify the effectiveness of algae settling and clarifier use viability. The data from these tests will then be utilized in the design of a clarifier. The purpose is to create an economical and environmentally sound harvesting technology that has low energy requirements.

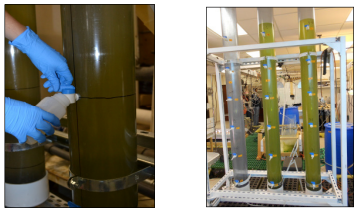


**Figure 2. Settling Columns filled with algae from raceways.**

## Results

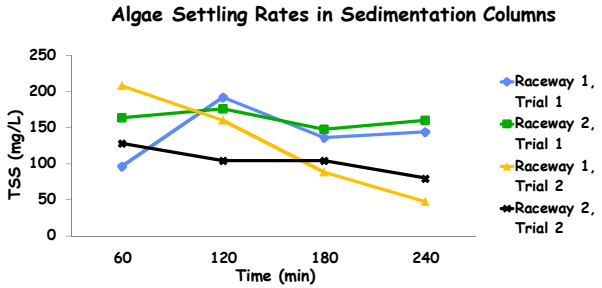



**Figure 3. Algae Settling in Design Columns over time**

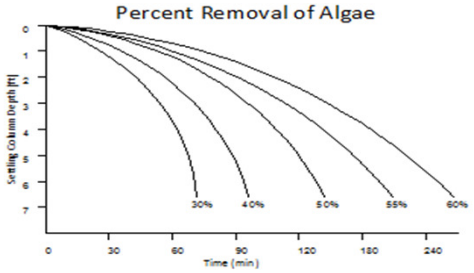



**Figure 4. Isoconcentration graph showing algae removal rates over time.**

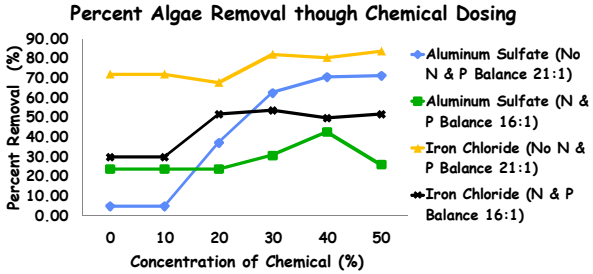


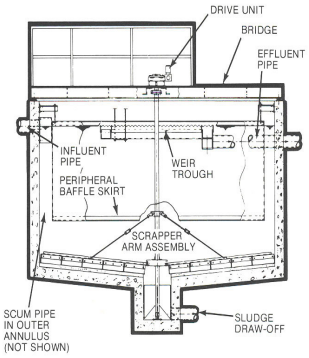

**Figure 5. Chemically induced removal of Algae**

**Figure 6. Jar tests were used for chemical testing.**

## Discussion/Recommendation

Data shown in Figure 4 illustrates algae settling rate over time. Results shown in Figure 5 indicate that a suspended solids removal efficiency of 40%-60% can be attained with a detention time of 1.5-3 hours. The surface overflow rate calculated in that time ranges between 50-70 ft/day. These key parameters will be used in the design of clarifiers.

Settling can occur without the addition of chemicals; however, the addition of chemicals can increase percent removal. Figure 6 shows that chemical dosing can increase algae percent removal. Results also indicate that culture age, nutrient availability, pH, surface charge, and algae concentration are key variables that can affect the degree to which algae settle. These factors can also affect the chemical concentrations required to increase percent removal and therefore require further study in order to successfully design a full scale clarifier.




http://www.pollutioncontrolsystem.com/Page.aspx/76/Circular-Mechanical-Clarifiers.html

**Figure 7. Section view of a secondary clarifier design used in wastewater treatment facilities.**

## Conclusions/Future Work

- Preliminary testing and a review of literature has shown that culture age, nutrient availability, pH, surface charge, and algae concentration are key variables that cause varying degrees of algae settling. Current research aims to quantify the results of these effects on algae settling rates.
- Clarifiers have been shown to be economical, environmentally sound, and have the potential to remove a large fraction of algae.
- Chemicals can be used to further enhance algal sedimentation by increasing the fraction of algae removed.
- Testing will continue to be conducted on a weekly basis to monitor the variables listed above, and quantify the effects of chemical dosing.
- Data collected and further research will then be used in the design of a full scale, economical and environmentally sound algae harvesting technology, that has low energy and cost requirements.

## Acknowledgments

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