Phosphorus Wastewater Treatment

Project Manager: Julia House

Members: Jasmine Prince, Michelle Nguyen, Evan Santos, Nicholas Wan, Arturo Medina, Ezequiel Ansaldi, Paige Park, Eleanor Quirk, Jackson Albright

May 18, 2019 AIChE Projects Showcase

Background

Excessive **Phosphorus** in the ocean causes a dramatic increase in the rate of algae growth; this can cause the affected body of water to have low oxygen content (eutrophication), which in turn causes high rates of death among marine life. Currently, **37 Areas** along the West Coast suffer from eutrophication and other issues related to nutrient runoff, and phosphorus runoff in particular. These affected marine ecosystems could be restored by **Reducing Phosphorus Runoff**. Since wastewater from agricultural runoff and sewage contains a high amount of phosphorus, recovering it before it reaches the ocean is important to restoring eutrophication-affected areas.

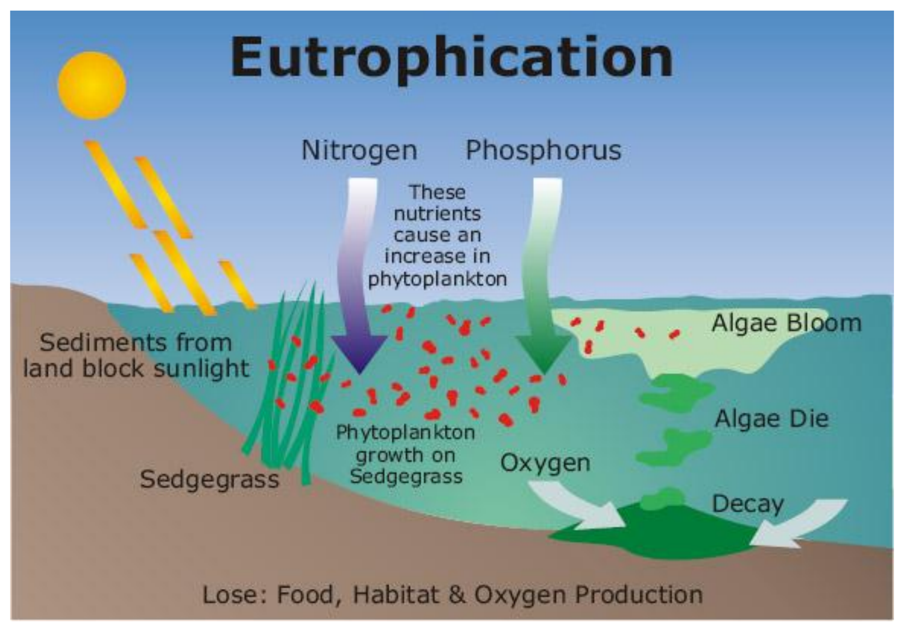

Figure 1 : The process of **Eutrophication.** Runoff **Phosphorus** depletes oceanic oxygen and results in aquatic dead zones.

The primary goal of PWT is recovering **Phosphorus** before it enters the ocean with a secondary goal of wastewater treatment. What differentiates our vision of Chemical Precipitation and Electrodialysis from industrial Municipal Wastewater incineration is a drastic reduction in carbon footprint.

Current Design & Results

PWT's process design consists of two stages:

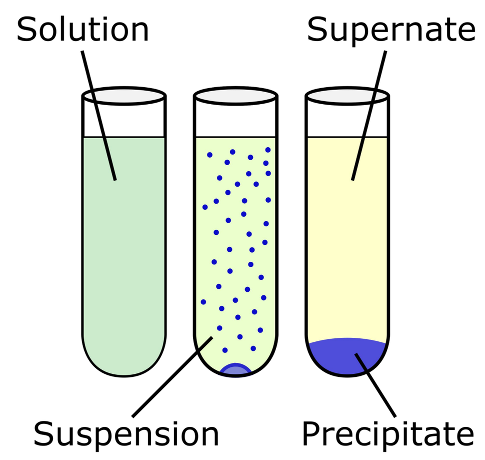

Figure 3: A diagram of Chemical Precipitation

Figure 4: A buckner funnel following precipitation of ($Ca_3(PO_4)_2$)

Chemical Precipitation: The initial goal is **Phosphorus** removal. Chemical precipitation allows for removal of **Phosphorus** through a precipitation reaction. A coagulant, $Ca(OH)_2$, in combination with a very basic medium and wastewater creates a precipitate of **Calcium Ortho-Phosphates**.

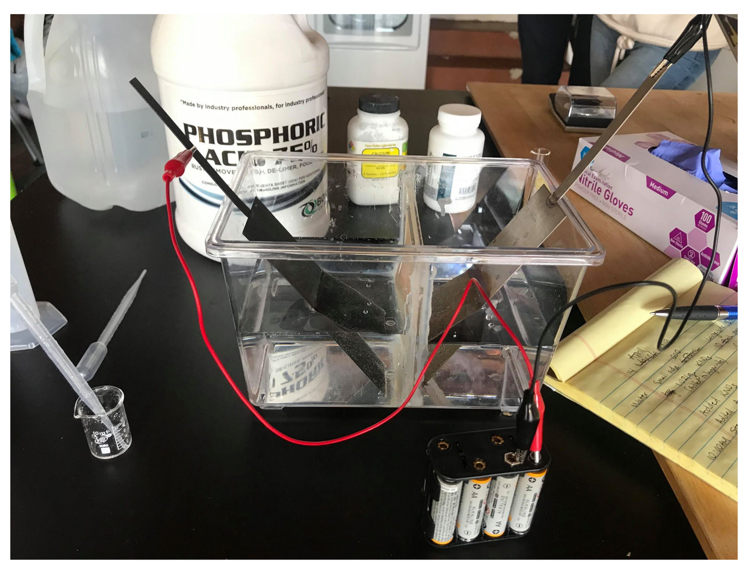

Figure 5: An assembled electrodialysis system

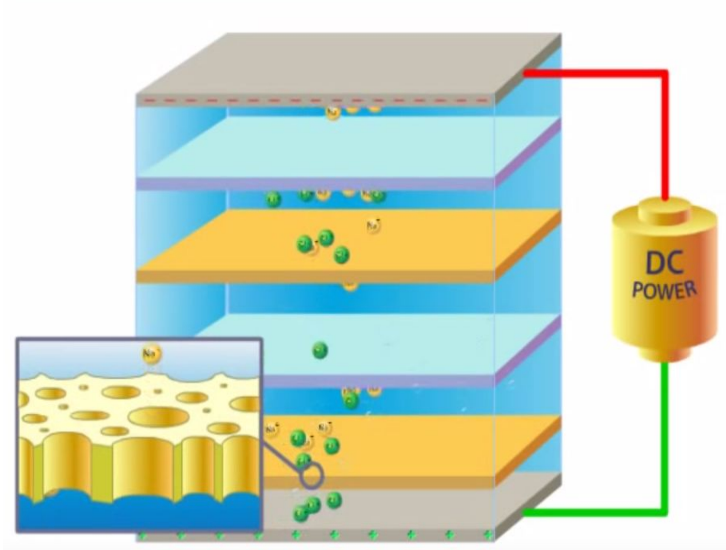

Figure 6: An electrodialysis model

Electrodialysis: The goal is separating any ions left in the supernatant following chemical precipitation. This is done with a membrane that is selective for the ions we desire. The end result is a separation of ions with an electric current leaving a stream of clean water and a stream of dirty water.

Path Forward

Our new goal is creating a continuous process by combining the two stationary phases of **Chemical Precipitation** and **Electrodialysis.** Our vision moving forward is the implementation of a modular design that will collect phosphorous and other impurities before they reach the ocean, and recycle the wastewater for agricultural use.

While we are currently using DI water to control our testing parameters, at some point in the future we hope to get into contact with SIO researchers or water treatment companies to be able to run our system using actual wastewater.

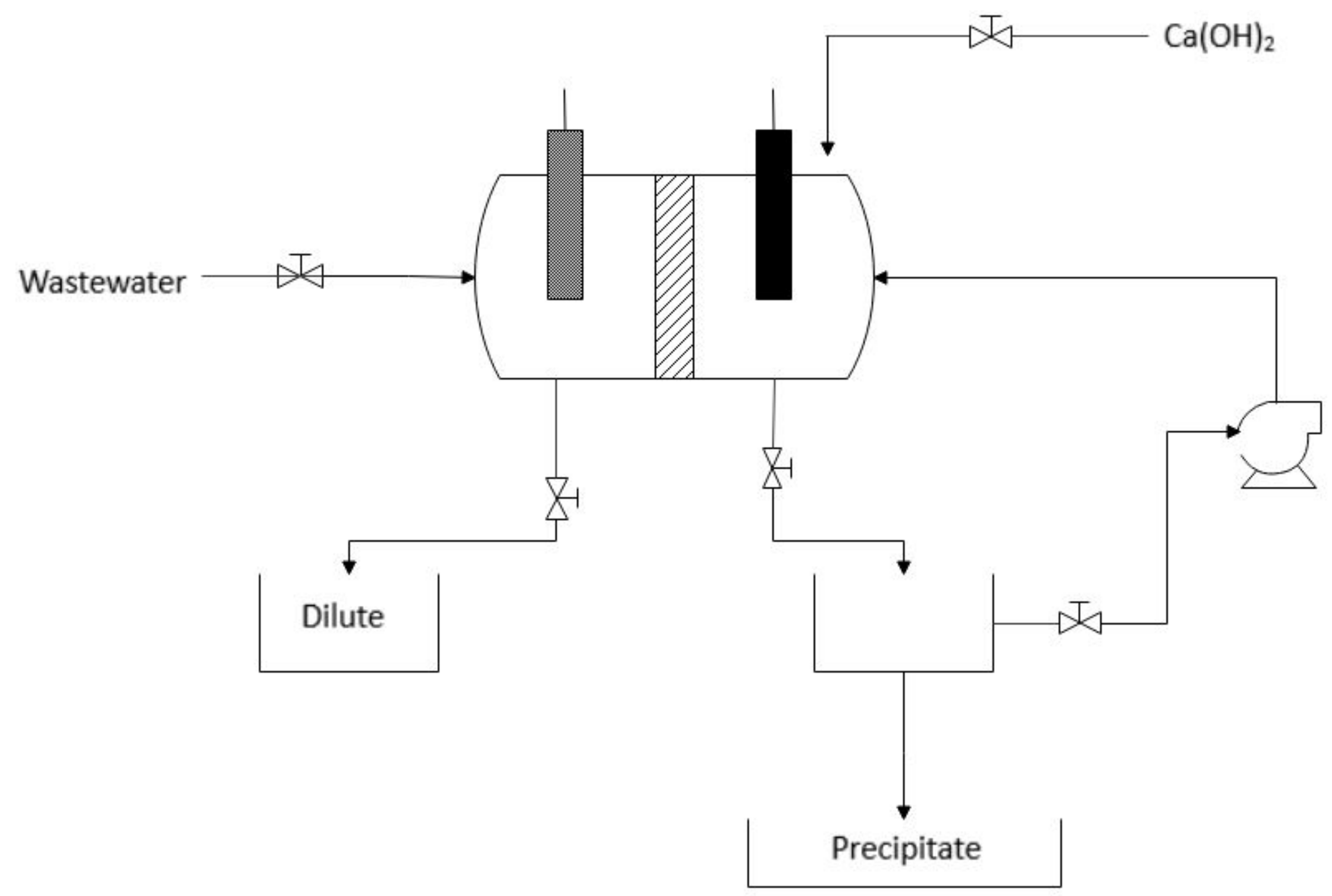

Figure 7: A combination of chemical precipitation and electrodialysis.

Acknowledgements:
Alexis Garcia - AIChE Program Director