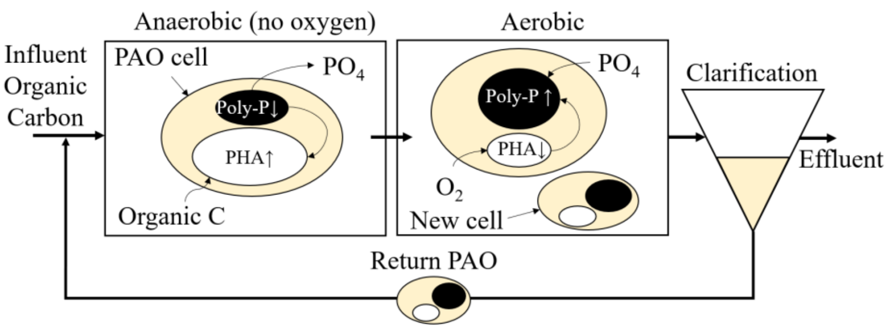
Introduction: Wastewater treatment plants (WWTP) are designed mainly for removing nutrients to prevent eutrophication in the receiving waters. Secondary goals of WWTPs are related to sustainability, which includes reduction of chemical usage and enhancement of resource recovery. Dr. Mari Winkler is conducting research to improve sustainable practices in wastewater treatment.

Background: Humans excrete almost 100% of the phosphorus consumed, and if not effectively treated at WWTPs, can have harmful effect on the receiving water. Phosphorus is also a non-renewable resource that is essential for all life, and the global phosphate rock reserves (the only phosphorus source on earth) are estimated to deplete by 2090. Phosphorus recovery can be done at WWTPs to produce fertilizer from human waste in the form of struvite ($MgNH_4PO_4{\cdot}6H_2O$). Therefore, phosphorus removal and recovery at WWTPs can have a significant impact on the water quality (via P removal) and on extending the life of phosphorus reserves (via P recovery). There are two methods for removing phosphorus: chemical precipitation and enhanced biological phosphorus removal (EBPR) (Figure below), but only the EBPR method allows for phosphorus recovery.



EBPR relies on a special type of bacteria, the polyphosphate accumulating organisms (PAO), that can remove the phosphorus from the water by storing it in their cells. In comparison to chemical treatment, EBPR is the more sustainable method as it does not require non-renewable minerals and allows not only for phosphorus removal but also its recovery.

Challenge Definition: Despite the EBPR's many advantages, it requires a stable microbial community, and if not carefully operated it can lead to system failure. Some EBPR plants with low influent carbon loading require dosage of external carbon source, which can lead to expensive operational costs if not optimized. These complexities make the EBPR process challenging for integration into most WWTPs. In fact, less than 5% of the WWTPs in the U.S. can immediately employ phosphorus recovery with EBPR.

Research Aim: This project aims to develop a new sensor technology that enables real-time monitoring and controls of the EBPR process, which will simplify operations, reduce costs while increasing phosphorus removal/recovery efficiencies at existing and future facilities.

Lab Tasks: The student will work with PhD student Stephany Wei to operate an EBPR bioreactor and conduct tasks needed for developing the sensor technology. Specific tasks include daily nutrient and solids measurements, sensor calibrations, batch tests and troubleshooting of the instrumentation and control systems. The student will also conduct molecular techniques to assess the health of the bioreactor microbial community.

General Matter: No funds will be available for salary or living expenses. University of Washington ranks 25th among world's universities. The Mercer Quality of Living Survey 2016 ranked Seattle on place 46 in the world.

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