University of Washington Graduate Research Fellowship Program
2014 Products

Graduate Research Fellowship Scholar -- Mariko Lust (completed degree)
Fate and Transformation Model of 17α-Ethinylestradiol in Activated Sludge Treatment Processes

Publications
1. Paper submitted and revised copy under review

Significance: The synthetic hormone, 17α-Ethinylestradiol (EE2) is considered one of the most lethal endocrine disruptor compounds found in municipal wastewater treatment plant (WWTP) effluents. Though it can be biodegraded in activated sludge systems, observed effluent concentrations have ranged from <1 to 40 ng/L (the no effect concentration to fish is below 1 ng/L). This research determined fundamental information, including partitioning coefficient values, biodegradation kinetics and deconjugation kinetics for EE2, leading to a comprehensive fate and transport model that can be used to predict EE2 removal performance as a function of a given facility design, operating condition and wastewater characteristics. The model can be used to determine most optimal conditions in King County WWTPs to minimize effluent EE2 concentration.

Graduate Research Fellowship Scholar -- Nicolette Zhou, PhD Student
(Completion of PhD research is expected by September 2015)

Publications


Conference Poster Presentations

Strain BiD32 Protein Expression During Bisphenol A Degradation” American Society of Microbiology General Meeting. Boston, Massachusetts (May 2014)

**Significance:** The biological degradation rate of many micropollutants is very slow compared to BOD removal and nitrification in municipal wastewater treatment and thus extensive increases in biological treatment tank volumes may be necessary to reach the extremely low effluent concentrations that are potentially necessary to protect aquatic life. This work has identified a number of isolated bacteria capable of degrading certain micropollutants at elevated rates and has proposed a method to enhance micropollutant removal efficiency by the growth of such organisms in a side reactor for addition to the mainstream biological treatment process; commonly termed bioaugmentation. The 2014 paper in Bioresources Technology by Zhou et al. and conference presentations and proceeding provided a model that assesses important factors that affect the treatment efficiency of the bioaugmentation process and can be used for process optimization. The presentation by Zhou in May 2014 provides information on the protein expression and thus related DNA genes of one of the bisphenol A degraders, which can lead to methods to assess the degradation activity in a biological treatment system.

NSF Research Contract to Support Collaborative Work with the Graduate Research Fellowship Scholar on Estrogen Removal -- Ryan Ziels
(Ryan Ziels completed his Master’s Degree in June 2013)

**Publications**

**Significance:** An important parameter in the estrogen fate and transport model developed by Mariko Lust in her work listed above is the activated sludge estrogen biodegradation kinetics. A key finding in the NSF research by Ryan Ziels was that activated sludge bioselector processes, which by their nature have different configurations, selected for different bacteria with different estrogen biodegradation kinetics. Thus, the work presented in this paper reports on the effect of bioselector processes, such as those used for sludge settling improvements and/or nutrient removal, on estrogen biodegradation kinetics and identified those that produced higher degradation rates.

Water Environment Research Foundation National Research Center for Resource Recovery and Nutrient Management -- Involves Collaborative Work with King County
Ryan Ziels (PhD student)

**Publications**

**Significance:** Anaerobic digestion used for municipal waste sludge or animal manure is viewed as a major opportunity for resource recovery and an important area for nutrient management as the digestion process releases high concentrations of ammonia and phosphorus into the liquid. Our project in this area is funded by the EPA through the WERF Center and is a joint effort with Washington State University to improve the environmental benefits and economics of manure waste management. We have also had prior projects on anaerobic digestion in the King County Graduate Research Program, which also included a co-digestion project for enhanced methane production. Our current publications and presentations from this center research recognizes the importance of syntrophic bacteria in the degradation of fats, oils, and greases (FOG) in co-digestion and is intended to lead to an operating strategy that can greatly increase methane production from FOG addition, while providing scientifically-based feeding strategies to prevent digester upsets from long chain fatty acid inhibition.