UNIVERSITY of HOUSTON

CULLEN COLLEGE of ENGINEERING

Department of Civil & Environmental Engineering

CIVE 6111 Graduate Seminar

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Environmental Applications of Titanium Dioxide Nanotechnology: Lessons from the Field

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2:45 pm - 3:45 pm
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Abstract: Titanium dioxide nanoparticles (TiO2 NPs), measuring 100 nm or less in diameter, are photo-reactive and produce reactive oxygen species (ROS) when exposed to sunlight. Research in laboratory systems have demonstrated the capabilities of TiO2 NPs to degrade organic compounds, adsorb heavy metals and disinfect water. However, field-scale validation of these laboratory studies has been limited. Working with local Oregon companies, Dr. Radniecki and his students have tested TiO2 NP-based technologies to treat a wide variety of contaminated waters including stormwater, surface water and high-strength waste streams.

TiO2 NP-based treatment systems effectively remove Cu2+ and Zn2+ from industrial stormwater while the removal of organic matter and coliform bacteria were less successful as they were hampered by turbidity and the presence of complex dissolved organics. When applied to the disinfection of surface water under ideal conditions, TiO2 NPs removed bacteria and viruses to WHO's "Highly Protective" status and Cryptosporidium to "Protective" levels within 3 hours. However, low temperatures, high turbidity, the presence of humic compounds and low light intensities significantly decreased the observed disinfection rates. These limitations were overcome through the addition of ClO2 which worked synergistically with TiO2 NPs to increase the production of ROS and disinfected surface waters to WHO's "Highly Protective" status in under 3 hours, even under the most challenging conditions.

On-going projects are scaling-up the surface water disinfection technologies from the current personal-use size (3L), up to community-use sizes (500 gallons) that can operate day and night (utilizing UV-LEDs). Additionally, we are exploring the use of concentrated solar light sources to increase ROS production and overcome the limitations of high turbidity and organic matter that are commonly found in landfill leachate, airport deicers and dairy manure effluents.

About the speaker:

Dr. Tyler S. Radniecki is an assistant professor in the School of Chemical, Biological and Environmental Engineering at Oregon State University. Dr. Radniecki earned a BS in Environmental Science from Bemidji State University (Bemidji, MN) and an MS and PhD in Environmental Engineering from Yale University. Dr. Radniecki's research interests includes the environmental implications and applications of nanotechnology, sustainable biological wastewater treatment, and green infrastructure stormwater treatment processes.