

**Environmental Engineering**

**and Earth Sciences**

**EEES Department Seminar**

**“role of bioelectrochemical systems in managing water-energy nexus issues”**

**PRESENTED BY**

Abhijeet P. Borole, Ph.D.

Biosciences Division, Oak Ridge national Laboratory, Oak Ridge, TN 37831 USA, [borolea@ornl.gov](mailto:borolea@ornl.gov)

Chemical and Biomolecular Engineering Department, Bredesen Center for interdisciplinary Research and

Education-Energy Science and Engineering Program, Center for Environmental Biotechnology

The University of Tennessee, Knoxville, TN 37996

**Abstract**: Bioelectrochemical systems (BES) are electrical devices that convert energy from waste, wastewater and biomass into usable energy or bioproducts, employing microorganisms as catalysts. Microbial fuel cells (MFCs) and microbial electrolysis cells (MECs) are common type of BES which can generate electricity and hydrogen from wastewater, respectively. The role of BESs in minimizing impact on water resources and maximizing energy production in biorefinery and oil and gas industry will be discussed.

All industrial processes generate waste and wastewater. Reclaiming this water and the energy resource in the waste is one strategy that can be employed to improve energy efficiency in industries of the future. Biomass conversion to biofuels via biochemical and thermochemical processes results in a process efficiency of 45-50%. An increase in efficiency to 70% is desirable. A significant portion of the biomass is converted to byproducts and other compounds, which end up in the waste stream, some of which are inhibitory to the biofuel production processes. Conversion of biomass pyrolysate and stillage from fermentation process to hydrogen and electricity will be discussed. Water recycle is an important consideration for improving resource utilization in the biorefinery. Removal of sugar- and lignin- degradation products such as furan aldehydes and phenolic compounds while generating energy will be demonstrated. The potential for improvement in overall biorefinery process efficiency via BES will be discussed. Challenges to implement this in the biorefinery including scale up of these systems will be addressed.

Fracking is changing the energy outlook in the US. At the same time, concerns regarding its effects on our environment are growing. Treatment of produced water using BESs can potentially introduce sustainable features in production of fossil energy and minimize impact on the environment. A synergistic process removing organics and salts from produced water will be presented. Results to date indicate increasing prospects for employing BESs to solve problems in the water-energy nexus area. Outlook of this technology and future needs will be discussed.

**Bio**: Abhijeet Borole is a chemical engineer with expertise in biomass conversion, waste to energy and bioelectrochemical systems. He is currently a Research Scientist at ORNL and holds a Joint Faculty appointment at the University of Tennessee, Knoxville in Chemical Engineering and Energy Science and Engineering program at the Bredesen Center. His research is focused on fermentation, microbial fuel / electrolysis cells and their applications in the biorefinery and the oil and gas industry. He has published 55 peer-reviewed papers, 4 patents and 3 books. His interests lie at the interface of biology, electrochemistry and engineering, targeting energy efficiency and electrosynthesis. He uses biofilms and develops practical strategies to convert low value resources to higher value products.

His other interests include water-energy-food nexus, bioreactor development, fossil bioprocessing, multiphase process design and environmental biocatalysis. Specific research includes microbial electrolysis, fuel cells, pyrolysis, syngas utilization, biodesulfurization, biological mercury removal and anaerobic digestion.

**2:30 PM – Friday, April 21, 2017**

**Hardin Hall 100**

***Refreshments following Seminar***