DREXEL UNIVERSITY
Civil, Architectural, and Environmental Engineering
College of Engineering

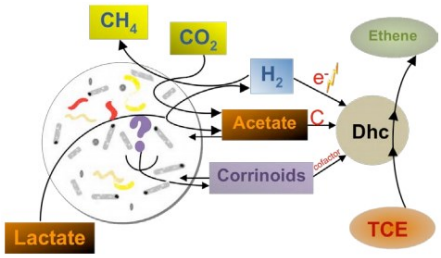
Guest Seminar in Environmental Engineering

Thursday, June 18, 2015 1:00-3:00pm | Curtis 250A

1:00-2:00pm

Dr. Yujie Men: Eawag, Swiss Federal Institute of Aquatic Science and Technology

Deciphering the ecological roles of supportive microorganisms for *Dehalococcoides mccartyi* in dechlorinating microbial communities



Chlorinated solvents, typically tetra-/tri-chloroethenes (PCE/TCE) are common groundwater contaminants in the U.S. *In situ* bioremediation via reductive dechlorination, as a cost-effective approach, has been applied to clean up polluted sites and protect public health from further exposure. *Dehalococcoides mccartyi* is the key microorganism that carries out the complete dechlorination to the benign end product ethene. However, the slow growth and fastidious nutrient requirements, such as external corrinoid co-factors limit its abundance and activities. Given that faster and more robust growth of *D. mccartyi* has been observed in communities, the overall goal of this study is to identify microorganisms supporting the growth of *D. mccartyi* with corrinoid co-factors, hence to identify potential diagnostic biomarkers for chlorinated solvent bioremediation processes. Dechlorinating enrichments without exogenous corrinoids were successfully constructed. Using analytical methods and a suite of molecular tools (i.e. meta-omics, real-time PCR, microarrays), the corrinoids produced in those enrichments were determined, with a predominant form of *p*-cresolyl cobamide. *Pelosinus* species were suggested to be the responsible corrinoid-producing bacteria. The microbial interactions between the suggested supportive microorganisms and *D. mccartyi* were further studied by constructing defined consortia. Results indicate that when the lower ligand of cobalamin was available, *D. mccartyi* was able to remodel *p*-cresolyl cobamide produced by *Pelosinus* species into cobalamin, the favorable form for reductive dechlorination via a CbiZ-dependent corrinoid salvaging and remodeling pathway. Potential biomarkers were then suggested for promoting better monitoring and diagnosis, hence more efficient bioremediation processes.

2:00-3:00pm

Dr. Jinyong Liu: Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign; Colorado School of Mines

Nanoparticle Hybrid Catalysts for Perchlorate Treatment in Water

Perchlorate (ClO_4^-) is an endocrine-disrupting drinking water contaminant, and the nationwide regulation of ClO_4^- by the U.S. EPA is pending. Our research team has been developing a series of novel biomimetic complex-nanoparticle hybrid catalysts to reduce ClO_4^- into innocuous Cl^- in water at ambient condition. Working mechanisms of these heterogeneous catalysts using rhenium (Re) as the oxygen atom transfer (OAT) center and hydrogenating metals (e.g., Pd) with H_2 for electron transfer resemble the processes in biological oxyanion reductases that contain a series of metal complex sites of variable Mo and Fe species. This presentation will report on our in-depth mechanistic insights of these catalysts, as well as rational design and synthesis of various Re complexes with tunable activity towards the preparation of heterogeneous catalyst with further improved sustainability. For example, beyond the traditional knowledge of "ligand enhancement" in metal-catalyzed environmental chemistry, coordination isomerism has been identified in our study as a determining factor of Re complex activity. Synthetic additives and ligand structure design have both been developed to eliminate the less active isomers and selectively harvest the much more active isomers. Rational combination of varied Re complexes and hydrogenation metals have also shown facile engineering controllability of performance and stability of these novel and promising catalysts for environmental applications.