DEPARTMENT OF CHEMISTRY AND ENVIRONMENTAL SCIENCE
SEMINAR SERIES
SPRING 2019

DATE: TUESDAY, APRIL 2
LOCATION: Central King Bldg. - 303
TIME: 1:00pm – 2:20pm

GUEST SPEAKER

Peter R. Jaffé
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TOPIC

Application of the Feammox process to remediate organic contaminants and the development of a Feammox bioelectrochemical reactor

ABSTRACT

The oxidation of ammonium (NH_4^+) under iron-reducing conditions, referred to as Feammox, is a pathway in the Nitrogen cycle where NH_4^+ is oxidized to NO_2^- and ferric iron [Fe(III)] is reduced to ferrous iron [Fe(II)]. The gnome of the organism responsible for this process, *Acidimicrobiaceae sp.* A6 (referred to as A6), has been sequenced, and a group of novel oxygenase-related genes were identified. Since oxygenases are key in the aerobic degradation of many organic compounds, we have tested and shown that pure and A6 enrichment cultures can degrade tetra- and tri-chloroethylene. Interestingly, the genome of A6 also contains genes for reductive dehalogenases, which are not expressed when NH_4^+ is oxidized under iron-reducing conditions. Incubations were conducted with a series of PFAS including PFOA and PFOS. Results show that all of these PFAS were defluorinated, at least partially and some completely, and that during the incubations the dehalogenase genes were expressed. Analyses of intermediates, fluoride ions produced, as well as Fe(II) produced and NH_4^+ oxidized during these incubations, show that that fluorine was used as electron acceptor during the deflourination of these PFAS. To our knowledge this is the first reported anaerobic mineralization of perfluorinated compounds such as PFOA and PFOS.

A challenge to operate a Feammox reactor is that the ratio of Fe(III) reduced to NH_4^+ oxidized is 6:1, which makes it impractical to operate such a reactor. Here we show that *Acidimicrobiaceae sp.* A6 is electrogenic and can grow in bioelectrochemical reactors without the need to add an Fe(III) source. The goal is to operate such reactors for the removal of the above-mentioned organics as well as NH_4^+.
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BIOGRAPHY

Peter Jaffé is the William L. Knapp '47 Professor of Civil Engineering, Professor of Civil and Environmental Engineering, and Associate Director for Research at the Andlinger Center for Energy and the Environment, at Princeton University. His background is in chemical engineering, and he obtained a Ph.D. in Environmental Engineering from Vanderbilt University in 1981.

He was a faculty member at the Universidad Simón Bolívar in Venezuela from 1983 to 1985 prior to joining the faculty of Civil Engineering at Princeton University in 1985, where he was department chair from 1999 to 2005. He was an AT&T Industrial Ecology Fellow, is an Elected Fellow of the American Geophysical Union, and was appointed as Board Certified Environmental Engineering Member of the American Academy of Environmental Engineers by Eminence.

His research focuses on processes governing the transport and transformation of pollutants in the environment, and their application towards the remediation of contaminated systems. Areas of current emphasis include: (1) simulation and analysis at the watershed scale of nutrient cycling; (2) dynamics of trace metals, radionuclides, and trace organics in sediments, wetland soils, and groundwater; and (3) novel biological processes for anaerobic ammonium oxidation and its applications for water treatment and cometabolic pollutant remediation.

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