**Biotransformation and Inhibitory Effect of Furanic and Phenolic Compounds in the Anode of a Microbial Electrolysis Cell (MEC)**

Spyros G. Pavlostathis, PhD, BCEEM, F.IWA, F.WEF, F.ASCE  
*Professor of Environmental Engineering*

School of Civil and Environmental Engineering  
Georgia Institute of Technology, Atlanta, GA 30332-0512, USA

**ABSTRACT**

Pretreatment of lignocellulosic biomass for biofuel production results in the formation of furanic and phenolic compounds, which are known inhibitors to H2- and ethanol-producing bacteria, and represent a challenge in biorefinery wastewater treatment. The present study assessed the biotransformation pathways and inhibitory effect of two representative furanic (furfural, FF; 5-hydroxymethylfurfural, HMF) and three phenolic compounds (syringic acid, SA; vanillic acid, VA; 4-hydroxybenzoic acid, HBA) in a MEC bioanode. Biotransformation of the five compounds occurred via fermentation, resulting in the production of acetate, which became the main electron donor for exoelectrogenesis. The extent of transformation was higher for the furanic compounds (67% of FF and 64% of HMF) than for the phenolic compounds (50% of SA, 14% of VA and 10% of HBA). The phenolic compounds transformed via a sequence of demethylation and decarboxylation reactions verified by the detection of metabolites by LC/MS-MS. Catechol and phenol were persistent transformation products of VA and HBA, respectively. All five parent compounds were inhibitory to exoelectrogens (IC50 = 1.9 - 3.0 g/L). Individual, non-inhibitory concentrations of the five compounds, when in mixture, resulted in severe inhibition. Microbial bioanode community analysis showed the presence of known degraders of furanic and phenolic compounds, fermentative bacteria, and exoelectrogens in syntrophic partnerships. This study advances our understanding of the biotransformation potential and inhibitory effect of furanic and phenolic compounds under redox conditions relevant to MEC bioanodes.

**BIOSKETCH**

Dr. Pavlostathis has more than 37 years of research experience in the area of applied environmental biotechnology and bioprocess engineering for the bioremediation of contaminated natural systems and the treatment of municipal and industrial wastewater. Recent research focuses on bioenergy production via co-digestion of high-strength waste and municipal sludge, as well as bioelectrochemical systems for hydrogen production and the upgrade of biogas from anaerobic digestion. He completed his MS and Ph.D. in Environmental Engineering at Cornell University after obtaining his Diploma in Agricultural Engineering at the Agricultural University of Athens, Greece. More details on Dr. Pavlostathis’ work can be found at: <http://www.ce.gatech.edu/people/faculty/961/overview>