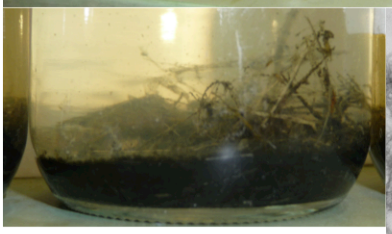

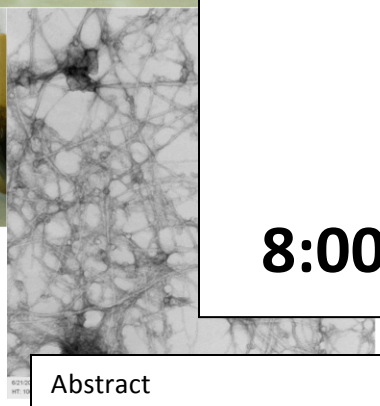

Assessing the Impact of Emerging Contaminants on Anaerobic Microbial Communities

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BIO

Leila Nyberg completed a Bachelor of Science degree in Biology at Kansas State University in 2001. Her M.S. research (2008) at Purdue University on C_{60} fullerene was part of a Nanoscale Interdisciplinary Research Team (NIRT) funded by NSF. This work became one of the earliest publications on the effect of nanomaterials on microbial communities. As an EPA STAR fellow, her PhD research on anaerobic environments shifted focus to carbon nanotubes and other emerging contaminants e.g. nonylphenol ethoxylate surfactants. She is also the founder of a start-up company developing technologies to capture value from high-strength wastewater for enhanced energy recovery.

Abstract

The impact of emerging contaminants on anaerobic microbial communities is critical and under-explored. Anaerobic processes are foundational to ecosystem function. Routes of chemical exposure to anaerobic communities include, wastewater discharge, drug delivery to ruminant livestock and land application of biosolids. Emerging contaminants are frequently used in consumer products, pharmaceuticals and nanomaterials are of particular concern because of their unique chemical and physical properties. Endocrine-disrupting nonylphenols, degradation by-products of surfactants found in consumer products, are established to be persistent and toxic to aquatic life in sediments. The research presented here consists of a survey of effects of these contaminants on anaerobic microorganisms. The relationship between microbial community structure and function was studied. Nanotube experiments were carried out with either digester sludge or cow rumen inoculum. Impacts of surfactants was examined in Celery Bog sediment. Microbial community function was measured with a biomethane potential assay. Sodium 2-bromoethanesulfonate, a known inhibitor of methanogenesis, was used as a toxic reference. Community structure was assessed with PCR-DGGE and 16s next-generation Illumina sequencing and metagenomics. Carbon nanotubes and their associated residual elements were characterized by TEM and EDX. Metals analysis in both solid and aqueous phases of microcosms was performed by ICP-MS. None of the carbon nanomaterials were found to be toxic. Several of the manufactured nanotube products were found to accelerate gas production and shift the microbial communities. These effects appear to be independent of metal or amorphous carbon content, or degree of nanotubes functionalization. A more pronounced effect was seen with increasing nanotube length, which is likely related to surface area. Surfactants in sediments resulted in significant enrichment of *Geothrix fermentans* in the presence of continuing methanogenesis but only moderate effects on community function. Carbon nanomaterials very substantially accelerate methanogenic activity, and may in fact facilitate biotransformation of recalcitrant biopolymeric material.