USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002FL2B

Title: Biological Transformation of 2-Methylisoborneol (MIB) for Improved Water Quality

Project Type: Research

Focus Categories: Water Quality, Treatment, Surface Water

Keywords: Activated Carbon, Adsorption and Exchange, Algae, Anaerobic Treatment, Bacteria, Biodegradation, Biological Treatment, Lakes, Trace Organics, Water Quality, Water Treatment

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Non-Federal Matching Funds: $48,767

Congressional District: 5

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Abstract

The number one customer complaint related to water quality in the United States stems from consumers receiving malodorous and unpalatable water. 2-methylisoborneol (MIB) is the compound most commonly linked to these taste and odor episodes. Since conventional treatment is ineffective for removing MIB from drinking water, and because these episodes are extremely prevalent in Florida, it is the focus of this research. This work will focus on an inter-disciplinary approach that combines microbiological degradation and biologically active sand/carbon to solve this drinking water quality issue. Our research objectives are:

1. To perform routine culturing and characterization of pure bacterial cultures shown previously to have the ability to transform MIB (Pseudomonas putida, Pseudomonas aeruginosa, and Bacillus subtilis).

2. To measure biodegradative activity of these pure cultures in the presence of MIB using oxygen uptake methods and resting-cell microcosms.

3. To enrich for MIB-degrading bacteria from sediment/water obtained from a lake not contaminated with MIB and from sediment/water samples obtained from a reservoir contaminated with MIB.

4. To measure biodegradative activity of the enriched mixed cultures in the presence of MIB using resting-cell microcosms.

5. To analyze for intermediate compounds formed as a result of pure- and mixed-culture transformation activity using GC/MS methods.

6. To assess the degree of odor in the identified intermediate compounds.

7. To determine the ability of various activated carbons to adsorb the identified intermediate compounds. 8. To optimize the removal of MIB in a BAAC system investigating ozone concentration, temperature, pH, and DO.

We anticipate that results from this work will help identify specific pathway(s) followed by these strains in transforming MIB, thus providing tremendous benefit to field engineers who face the MIB-contamination problem by allowing an assessment of whether these accumulated products may pose more of a problem than the MIB itself. Also, identification of these intermediates will aid in the design of a more effective adsorption medium. Moreover, the ability of various activated carbons chosen to target specific intermediates formed because of biological transformations will facilitate design of both in situ and ex situ treatment systems for the complete removal of MIB from water.

The research team includes Angela Lindner, a University of Florida (UF) assistant professor, who has published several papers on her work focusing on biological transformations of substituted aromatic and aliphatic compounds, molecular-level fundamentals of microbial transformation processes, and microbial ecology of mixed cultures. David Mazyck, is a UF assistant professor, interested in building an inter-disciplinary research program coupling his research interests that include activated carbon surface chemistry, thermal reactivation and activation of carbon, separation and adsorption phenomena, with biological and advanced oxidation processes to improve water treatment and air quality. Paul Chadik, is a UF Associate Professor, who has 20 years of experience in drinking water treatment research, with a major focus on disinfection by-product formation and control, and is currently pursuing ozone enhanced biofiltration in his research laboratory. We are requesting $24,371 from USGS and are pledging $48,767 in matching funds.