Trees and Microbes as Sustainable Nature-Based Treatment on Hydrocarbons and Mixed Waste Sites

Chris Cohu, John Freeman, Galen O'Toole, Renee Murphy and Edo Guttman, Intrinsyx Environmental

Background/Objectives.

To present advanced microbial technology and design methodology that improves the success rate and expands new opportunities for utilizing enhanced phytoremediation while meeting sustainability goals.

In 2014, Intrinsyx Environmental collaborated with NASA and the US EPA to introduce endophytic bacteria from Dr. Sharon Doty (University of Washington) with hybrid poplar trees to address TCE groundwater contamination at the MEW Superfund site(Doty et al., 2017).The success of this first pilot on has expanded to full-scale endophyte-assisted phytoremediation deployments on Superfunds, state-mandated clean-ups, and Fortune 500 redevelopment sites on 45 sites across the US, Austria and South Africa.

Endophyte-enhanced tolerance and appropriate trees, plants,and grasses selection of unique varieties are keys to successful phytoremediation on polluted sites with phytotoxic concentrations of both organic and inorganic contaminants.

Approach/Activities.

This presentation covers design methodologies and data from full-scale phytoremediation on several hydrocarbon and mixed waste installations utilizing Endophyte-Assisted Phytoremediation System (EAPS) technology as well as how they have been successful meeting sustainability goals. These synergistic bioremediation tools and innovative techniques have been deployed to address several classes of pollutants,including chlorinated VOCs, petroleum hydrocarbons, and 1,4-dioxane and in mixed waste.

Results/Lessons Learned.

Success with Phytoremediation comes from careful site assessment and selection of appropriate tree and microbe varieties. Special consideration of species selection to include both climate and native palette for optimal restoration efforts.

Data and lessons learned will be highlighted from contaminated sites across the U.S. where EAPS is currently installed to treat petroleum hydrocarbons, and 1,4-dioxane compounds insoil and groundwater. Among the lessons learned along the way, are confirmation that endophytes contribute to phytoremediation success and improved plant establishment, in-planta degradation, and enhanced source-zone depletion rates. Data suggests that the selection and application of appropriate endophytes are the key factors in plant establishment on sites with phytotoxic concentrations. Additionally, selecting site-appropriate tree varieties and providing them with consistent care is vital for establishment and long-term success on contaminated sites. EAPS now represents a standalone treatment for mitigating contaminant migration and in-situ degradation of soil andgroundwater contaminants.

Christopher Cohu

Dr. Christopher Cohu is a leading scientist in the field of plant stress physiology, phytoremediation, photosynthesis and plant productivity, and development of applied agronomic traits. Dr. Cohu received his undergraduate in Environmental Sciences from Western State Colorado University, and his Doctorate in Botany from Colorado State University and the Program in Molecular Plant Biology in 2009. Dr. Cohu has focused his research and career on phytoremediation, plant stress, and the roles of endophytes in assisting plant resilience, productivity, and remediation effectiveness. During his early career, Dr. Cohu directed a team of algae scientists at Solix Biosystems on wastewater effluent remediation, recycling and remediation of toxic byproducts from hydraulic fracturing fluids and gases, biofuel production, and nutraceutical market development. After Solix Biosystems he focused on researching and developing bio-technology methods to improve plant photosynthesis, biomass, and productivity under stressful environments including spaceflight and terraforming, for both crop and non-crop species.

Since 2007, Dr. Cohu has been active as cofounder and CEO of Phytoremediation and Phytomining Consultants United (PPCU). At PPCU he has directed remediation consulting and field deployment efforts to clean up heavy metals, metalloids, radionuclides and organic pollutant degradation using both plants and plant-associated microorganisms in terrestrial and aquatic ecosystems. In addition to consulting at PPCU, Dr. Cohu is Assistant Professor of Environmental Science and Technology at Colorado Mesa University where he teaches courses on pollution investigation and control.