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Hazardous waste site remediation of heavy hydrocarbons using biopolymer and polystyrene foam beads

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A sustainable, green chemistry process is proposed for the cleanup of coal tar and petroleum hydrocarbon impacted sediment and soil in < 2 hr. A mixture of proteins and polypeptides, extracted from corn gluten meal and hemp, when mixed with solids and polystyrene foam pellets (PFP), serves to mobilize heavy hydrocarbons, which sorb onto PFP. Since the sorbent floats, heavy hydrocarbons are easily extracted from the agitation vessel. An empirically-derived 4-dimensional surface response model predicts removal rates and operational costs under various experimental conditions. At optimum relative to cost, 81% of two to six ring polycyclic aromatic hydrocarbons (PAH) and 80% of the total hydrocarbon mass are removed despite the high organic carbon content (16.4%) and silty fines (~ 85%). Two cycles (n=2) of the same solid/biosurfactant mixture yields 94% extraction of PAH. Scanning electron microscope images illustrate free-phase tar (globule) sorption onto the foam. A field pilot was conducted in which 25 kg of sediment was processed. Results were in excellent agreement with both lab (10 g) experiments and model predictions. The process is considered sustainable and green because the active ingredients are derived from renewable crop materials, recycled polystyrene, and is recyclable, which reduces water demand and treatment costs, with recovered hydrocarbons used as fuel. Both large-scale batch and continuous process results confirm lab findings.

Biography

Albert Robbat, Jr., is the Directors of both the Tufts University Sensory and Science Center and Center for Field Analytical Studies and Technology and a member of the chemistry department. Professor Robbat's research interests include how climate affects the sensory and nutritional compounds in plant-based foods as well as developing green solutions aimed at investigating and remediating hazardous waste sites. Toward this end, Dr. Robbat has developed new instrumentation and data analysis software that provides the means to analyze target compounds in 5-10 min and detailed metabolomic profiles of plant-based materials.

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