

BIOSURFACTANT PRODUCTION AND THEIR APPLICATION IN ENHANCED PETROLEUM HYDROCARBON REMEDIATION

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The widespread use of light non-aqueous phase liquids (LNAPL) has resulted in the contamination of valuable groundwater resources, frequently in the form of petroleum hydrocarbon products. LNAPL solubilities are too low for effective remediation by conventional pump-and-treat technology, yet are too high to meet drinking water standards. In this study, surfactant-enhanced subsurface remediation (SESR) was used to reduce the time required to remove LNAPLs from the subsurface by improving LNAPL solubility and/or mobility using biosurfactants at low concentrations. Since the economic competitiveness of surfactant-based technologies requires that the mass of surfactant be minimized to recover the free-phase LNAPL, the effectiveness of using biosurfactants at low concentration is highly attractive. The overall objective of this research is to assess the relative technical and economic efficiency of using biosurfactants and their mixtures to recover free-phase LNAPL as compared to synthetic surfactants. Data will be presented on several two-component interactions, namely: surfactant-oil interactions, surfactant-medium interactions, and surfactant-water interactions. Two types of biosurfactants, lipopeptides and rhamnolipid, and four petroleum hydrocarbons, toluene, hexane, decane and hexadecane, were investigated. We found that both biosurfactants produce low interfacial tension (IFT) for petroleum hydrocarbons at the concentration as low as 0.1 wt%, but rhamnolipid biosurfactant produced lower IFT, and thus had better characteristics in removing petroleum hydrocarbon from subsurface contaminated water. Mixtures of rhamnolipid and Alfoterra® 68 synthetic surfactant were also studied and showed even lower IFT values, values as low as 0.01 mN/m, which is desirable in solubilizing and mobilizing LNAPLs. Comparisons in oil removal efficiency between biosurfactant and synthetic surfactant, and between single surfactant systems and mixed surfactant systems were also demonstrated in this study.