Bioelectrochemical cells (BES) for Electrogenesis and Bioelectrochemical Treatment of Petroleum Based Hydrocarbons Contaminated Soils

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Abstract

Petroleum hydrocarbons generating from the different activities of petroleum industry are contaminating the soil environment. Produced water (PW) and petroleum refinery wastewaters (PRW)producing in huge quantities, inadequate management of these wastewaters is exhibiting adverse effects on ecological and human health. Total petroleum hydrocarbon (TPH) is lethal to beneficial soil organisms and human beings, which created serious concern among the research fraternity and governments. Environmental contamination and ecosystem deterioration is a global concern that demands innovative and cost-effective remediation technologies. In this direction, soil-based bioelectrochemical systems (BES)were evaluated for ecosystem restoration, bioelectrochemical treatment of total petroleum hydrocarbons (TPH). Microbial fuel cells (MFCs) were evaluated for the treatment of petroleum hydrocarbons. MFCs facilitated bioelectricity generation along with the treatment of hydrocarbons in the soil matrix. The optimum TPH concentrations for degradation were identified by evaluating the different TPH loading rates in the soil matrix. MFC also facilitated for removal of sulfates. Further, a hybrid soil BES system embedded with bioanode and biocathode in soil matrix was operated through the external applied potential (microbial electrolysis cell mode, MEC). Hybrid soil BES facilitated bioanodic oxidation and biocathodic reduction in single system assisted for improved degradation rates by using minimal energy input. Both soil-based MFC and MEC were demonstrated as a sustainable process for the treatment of hydrocarbon contaminated soils.

Key words:petroleum hydrocarbons, produced water (PW), petroleum refinery wastewater (PRW), microbial fuel cells, sulfate removal, TDS removal, biostimulation