Design Criteria for Successful Biodegradation of Hydrocarbon Contamination in Soils and Groundwater

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Abstract. Hydrocarbon contamination is associated with the oil and gas industry in both the upstream and downstream sectors. Biodegradation is an effective remediation technique for hydrocarbon contamination. However, professionals working in the field of remediation projects find that the rate and the extent of biodegradation process vary significantly depending on field conditions. Design of variables limiting the success of bioremediation projects is a major challenge.

Electron acceptors, micro-organisms, enzymes, pH, salinity, temperature, nutrients, trace metals are among variables that affect the extent and rate of biodgradation. This paper discusses the design factors and their effect on remediation of hydrocarbon contamination in soils and groundwater.

A field scale application was set as part of the evaluation and design of the various variables. Six hundred barrels of petroleum hydrocarbon contaminated soil in the Egyptian western desert was set for remediation. Augmented biodegradation was applied on the contaminated soil for remediation. The initial total petroleum hydrocarbon (TPH) was 380 mg/kg. Landfarming was used to provide the air entrainment in the soil and thus supplying the electron acceptor element required for biodegradation.

This paper discusses the results and rate of biodegradation for the field test. Temperature has been found to have a dramatic effect on the rate of biodegradation. Almost no biodegradation occurred during the winter month of this project. Addition of external micro-organisms to enhance the microbial activities was essential for the project. The micro-organisms assisted in providing the initial energy to initiate the biodegradation reaction. On the other hand, nutrient (specifically nitrogen) was required for the microbial activity. Calculations of required nitrogen content are also presented in the paper. The achieved biodegaradation rate due to balancing of the various variables will assist researchers and professionals in the field to maintain their related projects.

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