Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
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EXPERIMENTAL STUDY OF THE IN SITU REMEDIATION OF LOW PERMEABILITY SOILS BY BIOVENTING

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Abstract

The goal of the present work is to evaluate the efficiency of bioventing on low permeability soils stimulated with hydraulic fractures, and polluted by a mixture of semi-volatile and non-volatile hydrocarbons. A synthetic non-aqueous phase liquid (NAPL) composed of 5 hydrocarbons is prepared: 1,2,4-trimethylbenzene (TMB), methylcyclohexane (MCE), n-dodecane (n-C_{12}), n-decane (n-C_{10}), n-eicosane (n-C_{20}). The capacity of indigenous bacteria to degrade high NAPL concentrations is evaluated with bioventing tests on small soil reactors under favorable and unfavorable conditions. Then, soil polluted with synthetic NAPL at an average concentration ~30g/kg-soil is packed in a tank (0.5m x 0.55m x 0.12m) of poly-methyl-methacrylate (PMMA) and two lenses of coarse-grained sand act as inlet and outlet hydraulic fractures. After the completion of bioventing tests, soil samples are collected to measure the NAPL concentration and composition as well as the potential growth of micro-organisms. A simplified numerical model of ventilation is used to estimate the contribution fraction of volatilization to the overall process efficiency. The NAPL concentration is reduced uniformly over the soil, the indigenous bacteria of soil are active even under toxic conditions, whereas biodegradation is enhanced weakly by the presence of nutrients. The contribution fraction of ventilation to the remediation efficiency is significant for the most volatile compounds (MCE), moderate for the less volatile compounds (TMB, n-C_{10}), and negligible for the non-volatile compounds (n-C_{12}, n-C_{20}), and hence biodegradation is responsible of the removal of a respectable percentage of semi-volatile and non-volatile NAPL compounds.

Key words: bioventing, hydraulic hracture, non-aqueous phase liquid, soil remediation, volatilization

Received: September, 2013; Revised final: January, 2015; Accepted: January, 2015

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