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Bioremediation Potential in Recalcitrant Areas of PCE in Alluvial Fan Deposits

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Abstract : In the transition zone between aquifers and basal aquitards, the perchloroethene (PCE)-pools are more recalcitrant than those elsewhere in the aquifer. Although biodegradation of chloroethenes occur in this zone, it is a slow process and a remediation strategy is needed. The aim of this study is to demonstrate that combined strategy of biostimulation and in situ chemical reduction (ISCR) is more efficient than the two separated strategies. Four different microcosm experiments with sediment and groundwater of a selected field site where an aged pool exists at the bottom of a transition zone were designed under i) natural conditions, ii) biostimulation with lactic acid, iii) ISCR with zero-value iron (ZVI) and under iv) a combined strategy with lactic acid and ZVI. Biotic and abiotic dehalogenation, terminal electron acceptor processes and evolution of microbial communities were determined for each experiment. The main results were: i) reductive dehalogenation of PCE-pools occurs under sulfate-reducing conditions; ii) biostimulation with lactic acid supports more pronounced reductive dehalogenation of PCE and trichloroethene (TCE), but results in an accumulation of 1,2-cis-dichloroethene (cDCE); iii) ISCR with ZVI produces a sustained dehalogenation of PCE and its metabolites iv) combined strategy of biostimulation and ISCR results in a fast dehalogenation of PCE and TCE and a sustained dehalogenation of cisDCE. These findings suggest that biostimulation and ISCR with ZVI are the most suitable strategies for a complete reductive dehalogenation of PCE-pools in the transition zone and further to enable the dissolution of dense non-aqueous phase liquids.

Keywords : aged PCE-pool, anaerobic microcosm experiment, biostimulation, in situ chemical reduction, natural attenuation
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