In-Well Tests to Determine Indigenous Naphthalene Biodegradation under Sulfate Reducing and Methanogenic Conditions

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The McCormick & Baxter Superfund Site, is a former creosoting manufacturing site located in Stockton, CA, that operated from 1942 until 1991. Poly aromatic hydrocarbons (PAHs) characteristic of creosote contamination are present in the groundwater, as well as other petroleum hydrocarbons. Historical data show that naphthalene, which is wide-spread at the site, has migrated in the groundwater significantly less than expected hydrogeolologically, suggesting that degradation of naphthalene is occurring. The data from this study, along with data from additional biological studies, will be used in a groundwater model to evaluate the feasibility of using monitored natural attenuation as a stand-alone alternative and in combination with other technologies for the remediating the groundwater.

The purpose of this study was to determine the ability of the indigenous microbial community to degrade naphthalene under the generally sulfate reducing and methanogenic conditions in the groundwater. Field tests were conducted using Bio-trap sampling devices enriched with ^{13}C naphthalene. Twenty two in situ tests were conducted in nineteen different locations, which generally represented either sulfate reducing or methanogenic conditions from source or fringe plume areas across the five different aquifer zones where PAH contamination is present. After field incubation the Bio-traps were analyzed for ^{13}Carbon in the microbial lipid biomass, residual ^{13}Carbon naphthalene in the trap, the ^{13}Carbon in the carbon dioxide captured by trap beads, and ^{13}Carbon in the methane captured by the trap. The groundwater in equilibrium with the Bio-trap was also analyzed for anions and non-^{13}C -enriched dissolved gases (methane and carbon dioxide).

Of the nineteen locations tested all locations had measurable enriched ^{13}Carbon in the microbial lipid biomass. Measurable enriched ^{13}C CO_2 was detected at eight locations across the site. There was no ^{13}Carbon above background measured in methane recovered from the traps at any location. The ability of the microbial community to degrade naphthalene appears to be widespread across the site, with the type of terminal electron acceptor process (TEAP) and physical location (aquifer zone) both influencing the microbial community biomass, composition, physiological status and the resulting naphthalene degradation.

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