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Dissolved Hydrogen Dynamics Associated with Emulsified Vegetable Oil Bioremediation of Chlorinated Ethene-Contaminated Groundwater

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Background/Objectives. Background/Objectives. Emulsified vegetable oil (EVO) is widely used as a fermentable carbon source to enhance the reductive dechlorination of chlorinated ethenes (CEs) in groundwater systems. EVO fermentation produces molecular hydrogen (H2) and possibly simple organic acids such as acetate, which act as electron donors driving microbially mediated reductive dechlorination of CEs. While EVO is widely used in bioremediation, few studies have actively monitored concentrations of H2 following EVO addition. The present study presents data showing how H2 and CE concentrations changed over time following EVO addition in a sandy coastal plain aquifer underlying Naval Air Station (NAS) Pensacola, Florida, and in a fractured rock aquifer underlying the Naval Air Warfare Center (NAWC) in West Trenton, New Jersey.

Approach/Activities. Approach/Activities. Concentrations of dissolved H2 were monitored before and after EVO addition to CE-contaminated source areas at both the NAS Pensacola and NAWC sites. H2 concentrations were measured periodically in the field using gas chromatography with reduction gas detection.

Results/Lessons Learned. Results/Lessons Learned. H2 concentrations were in the range characteristic of Fe(III)-reducing conditions (0.2-0.8 nanomolar (nM)) prior to EVO addition at both the NAS Pensacola and NAWC sites. H2 concentrations at the NAS Pensacola site increased to 25,000 nM 1.6 years after EVO addition, decreased to 2,400 nM four months later, and by 4 years after EVO addition H2 concentration had declined to 4.1 nM. In contrast, H2 concentrations at the NAWC site increased only to 25 nM two months after EVO addition, and declined to 1.6 nM six months after EVO addition. In part, these differences in peak H2 concentrations reflect the much greater volume of EVO used at NAS Pensacola (~65,000 L) than at NAWC (~100 L). At both sites, however, EVO increased observed rates of CE reductive dechlorination. The observed parabolic H2 concentration-time curves may reflect a gradual decline in EVO fermentation rates. However, it is likely that these curves also reflect an increase in the rate of microbial respiration over time, bringing rates of H2 production by fermentation into balance with rates of H2 consumption by respiration.