Evaluating the Remedial Effectiveness of Four Emulsified Substrates in Anaerobic In Situ Bioreactors

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Background/Objectives. In situ bioreactors (ISRBs) each equipped to inject four different commercially available emulsified electron donor were used to enhance anaerobic bioremediation at an industrial facility in New Jersey. In addition, the sustained bio-augmentation via the ISBRs was compared to the traditional batch injection of EVO and bio-augmentation culture. Each substrate was operated in duplicate. Chemical, geo-chemical and microbial analysis were collected from the ten remediation wells and five adjacent monitoring wells. Project objectives included determining which substrate produced the most favorable growth in targeted microbial communities in the initial phase and for the duration of the assessment.

Approach/Activities. ISBRs induce positive shifts in microbial growth and corresponding chemical reductions. The ISBR operates by providing small quantities of electron donor into the absorptive, Bio-Sep media within the ISBR to culture the present indigenous organisms. Four different substrates were used in duplicate to determine the remedial efficacy of each substrate when used in concert with the ISBR. The electron donors utilized at the site were Microemulsion ELS (Peroxychem), emulsified vegetable oil EVO (TerraSystems), EVO (EOS), and ERD Provectus. ISBRs were installed in remediation wells RIP-1 through RIP-8; each substrate was injected in duplicate (for example, EOS was injected in RIPs 1 & 2). Nano-scale zero-valent iron (nZVI) was injected into one of the well couplets to lower the levels of chlorinated solvents prior to bio-remediation to evaluate if pH would inhibit biological growth. This study also evaluated the pre-incubation of an ISBR (RIP-9) with commercially available reductive dechlorination culture to compare and contrast vs. the ISBR standard operation of culturing the indigenous microbial community. Lastly, a traditional batch injection of EOS EVO followed by the injection of commercial culture was also evaluated (RIP-10).

Results/Lessons Learned. Significant growth in key microbial communities was observed in the first sampling event (90 days) after the commencement of remediation with all electron donor products. The most positive initial shifts were observed in the PCE and TCE respiring bacteria (Dehalobactor, Desulfitobacterium, etc.), populations increased up to six orders in magnitude. Small shifts *Dehalococcoides* were observed in select wells, which is common as this organism typically requires more time to grow which will be confirmed in the subsequent sampling events. With the exception of the ELS , the ISBRs outperformed the pre-inoculated ISBR (RIP-9) and the batch injection (RIP-10). Corresponding chemical reductions were also significant, as PCE levels were reduced from 130,000 to 16,200 mg/L (RIP-1). Results from 3, 6, 9 and 12 month sampling events will be compared and contrasted.