Site-Specific Reductive Dechlorination Designs Bundling Multiple Abiotic with Biotic Reagents: Lessons Learned

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Background/Objectives. Carbon substrate electron donors for enhancing anaerobic bioremediation and zero valent iron (ZVI) for chemical remediation have been important tools for remediation practitioners for more than two decades. Enhanced in situ dechlorination (EISD) through injection of both carbon substrate and reactive iron has become a more common approach for treatment of chlorinated volatile organic compounds (CVOCs) taking advantage of biotic and abiotic dechlorination processes. Especially during the past five years, the number and variety of carbon substrate with ZVI remediation amendments has greatly increased. Each of these different EISD reagents has different properties and consistencies.

Approach/Activities. Remediation effectiveness can be improved by developing site-specific remedial design developed around the site conceptual site model, geology, contaminant concentration range, plume size, geology, and sensitive receptors. The presentation will provide an overview of four case studies where a site-specific remedial design was developed utilizing multiple EISD reagents and/or EISD formulations developed specifically for a given site.

Case Study #1 is a small overburden treatment area adjacent to a pond where different EISD reagents, including sodium lactate, lecithin, glycerol with ZVI, and emulsified vegetable oil (EVO) with ZVI, were used vertically and spatially based on the range of CVOC concentrations and protecting surface water quality and nearby utilities.

Case Study #2 features the treatment of a bedrock source area using both small and large droplet emulsified vegetable oil (EVO) products along with ZVI to achieve potentially contrary objectives of establishing persistent anaerobic conditions and encouraging migration of dissolved organic carbon to enhance natural attenuation downgradient of the injection area.

Case Study #3 features treatment of CVOCs in bedrock using EVO and two different ZVI particle sizes: 4 micron to achieve rapid dechlorination and 44 micron to provide a large mass of iron for longer term treatment.

Case Study #4 is a permeable reactive barrier with high hydraulic conductivity soils. A specialized blend of EVO developed for aquifers with high seepage velocity was utilized with added ZVI.

Results/Lessons Learned. These case studies each achieved their desired site-specific objectives through a remedial design process that selected combinations of EISD reagents based on identified strengths for addressing site-specific challenges. Short-term and long-term monitoring results will be presented for the case studies.