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Remedial Approaches for In Situ Anaerobic Bioremediation

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Background/Objectives. This presentation will describe the remedial design approaches for three sites with chlorinated solvent contamination in groundwater. The three sites represent different challenges: one site has a large dilute tetrachloroethene plume in an aerobic sandy aquifer with low groundwater pH; the second site has a trichloroethene plume in an anaerobic geochemically complex silty sand formation with slow groundwater movement; and, at the third site, a source area with highly complex and concentrated mixture of chlorinated and brominated ethenes and ethanes in a sandy silt and silty clay aquifer.

Approach/Activities. The design of an in situ bioremediation remedy must answer the following fundamental questions: What are the effective amendments to be used? What is the delivery mechanism for effective amendment distribution? What are the practically achievable remediation goals? What is the target treatment zone? How long will it take to achieve the remediation goals? What are the life-span costs of a remedial action?
To answer these questions, pilot studies were conducted at the three sites. The pilot studies included collecting design parameters and site-specific information to support management decisions. The studies were designed either using a biobarrier configuration for treating contaminant plume or with direct treatment at a source area. Several amendments and amendment delivery methods were tested. The amendments included EHC®, emulsified vegetable oil (EVO), and sodium lactate, with sodium bicarbonate for pH adjustment. The amendment delivery methods included well injection, direct push injection, direct push injection using hydraulic fracturing or pneumatic fracturing, and recirculation between wells. Data collected from each of the pilot study and how these data were used in the remedial design will be discussed in this presentation.

Results/Lessons Learned. A summary of the remedial approaches based on site specific conditions will be presented. Information will include the applicability of EVO, EHC, and sodium lactate for a biobarrier application or a source zone treatment; the effectiveness of pH adjustment under different flow systems; the amendment delivery methods suitable for different geology and hydrogeology conditions; the management decision on determination of the treatment zone based on the level of contamination and site specific constrains; and the ability of in situ bioremediation to meet site remediation goals. Furthermore, the importance of including natural attenuation in the consideration of overall remedial action strategy will be discussed.