An Innovative Solution for Sits with Low-Permeability Geology: Electrokinetic (EK) Amendment Delivery for In Situ Remediation

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In-situ remediation technologies such as enhanced in-situ bioremediation (EISB) and in-situ chemical oxidation (ISCO), while capable of treating various contaminants in sandy aquifers, have often failed to achieve remediation goals at sites with low-permeability (low-K) zones. Advances in the understanding of mass distribution in plumes have highlighted that in many cases the majority of contaminant mass is stored in low-K zones, and that slow back-diffusion from these zones represents a long-term contaminant source. Conventional remediation amendment delivery based on hydraulic advection mechanisms is often ineffective in low-K materials and/or highly heterogeneous geology. This presentation will discuss electrokinetically (EK)–enhanced amendment delivery as a fundamentally improved solution to this critical challenge facing remediation practitioners.

EK-enhanced amendment delivery involves the application of low-voltage direct electrical current (*DC*) to target contaminants in low-K and/or highly heterogeneous aquifers and aquitards. An established subsurface *DC* electric field induces the movement of porewater, ions, and even charged particles by electroosmosis, electromigration, and electrophoresis, respectively. EK transport of ionic substances is relatively independent of hydraulic properties of the geologic matrix and results in effective and uniform amendment delivery within target areas. This presentation will describe results from multiple field-scale demonstrations and technology development of EK-BIO and EK-ISCO where EK processes are engineered to deliver bioremediation amendment (lactate and bacteria) and chemical oxidant (persulfate).

The presentation will discuss the fundamentals of the EK technology and three case studies. The case studies include a full-scale EK-BIO remedy in Denmark for a PCE DNAPL source area, a EK-BIO technology demonstration in Florida, and a EK-ISCO pilot test at a Superfund site in North Carolina.