Accelerating Redevelopment of Contaminated Sites Remediated with *In-Situ* Soil Mixing

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Abstract. The industrial use of chlorinated solvents (e.g., tetrachloroethylene, trichloroethylene) has been widespread over the past half century. Unfortunately, inadvertent leaks, spills, and improper disposal practices have affected widespread contamination of ground water with these solvents. Past remediation technologies, such as pump-and-treat, have had limited success in cost-effectively restoring aquifers to typical cleanup levels. Deep soil mixing techniques, which deliver zero valent iron (ZVI) in the form of a suspension (slurry) with clay (ZVI-clay) to treat and remediate chlorinated solvent source zones *in situ*, represent a promising treatment alternative in terms of efficacy and cost

The underlying principle of the ZVI-clay technique is to use standard geotechnical equipment for deep soil mixing to (1) homogenize soils and contaminants in source zones and (2) introduce a uniform mixture of ZVI particles and clay. The particulate iron is a reactive media that drives reductive dechlorination of chlorinated solvents. The clay plays a number of roles including improving the uniformity in the distribution of the iron, reducing flow through the source (greater time for reactions to proceed and reduced contaminant flux), and reducing the mechanical energy needed to mix soils. The addition of the clay and iron in the form of a slurry to the contaminated soil, usually a highly permeable, coarse-grained aquifer material with very low compressibility, results in a treated zone with the consistency similar to molasses that is very low in strength and highly compressible. In this condition, the treated zone is not readily adaptable to economic redevelopment until consolidation of the treated zone occurs. However, because of the reduction in permeability of the treated zone due to the addition of the ZVI-clay suspension, consolidation of the treated zone can take from months to years, depending on the size of the treated zone and the site soils.

In this study, a series of laboratory experiments was performed on mixed specimens to measure strength and compressibility (consolidation) parameters. Specimens were tested for compressibility in oedometer (consolidation) tests with vertical drainage, Rowe (hydraulic) cell tests with radial and/or vertical drainage, and constant-rate-of-strain (CRS) tests with vertical drainage. The parameters obtained from each of these tests are used to evaluate the depth profile of a ZVI-clay mixed column of soil, and assess the viability of various methods for accelerating consolidation at a treated site. A field study has been proposed to validate laboratory results and determine the practicality and effectiveness of available consolidation acceleration techniques.

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