# Evaluating consolidation of large columns of sand mixed with zero-valent iron and clay slurry for remediation

Gustavo Vianna[1], Charles D. Shackelford[2], and Tom Sale[3]
Department of Civil and Environmental Engineering, Colorado State University

**Abstract.** Contamination of ground water by chlorinated solvents (e.g., trichloroethylene, perchloroethylene) due to past improper disposal techniques, spills or inadvertent operational leaks is a contemporary reality. *In-situ* remediation techniques such as soil mixing represent a promising alternative to cost-effectively restore aquifers to typical clean-up levels. Amongst these recent technologies, the delivery of zero valent iron (ZVI) in the form of a suspension with clay (ZVI-Clay) is of particular interest in terms of efficacy and cost.

The basis of the ZVI-Clay technique is the employment of standard soil mixing equipment to: (1) reduce the heterogeneities within the soil profile, (2) introduce a uniform mixture of ZVI particles and clay, and (3) create a homogeneous mass of soil, contaminants, stabilizing (clay) and reactive (ZVI) agents. Remediation is achieved through a combination of reductive dechlorination of chlorinated solvents by the particulate iron, and mass stabilization by the highly impervious clay slurry, which also reduces flow through the source zone and contaminant flux.

The injection of ZVI-Clay slurry into the contaminated soil may, however, result in decreased soil strength and increased compressibility of the mixed treated zone such that economic redevelopment can not be undertaken until consolidation is sufficient to impart adequate strength and compressibility. Because of the drastic reduction in permeability of the treated zone (a primary benefit of this technology), consolidation of the soil strata could take months to years, depending on individual site soil parameters.

Accordingly, the primary focus of this study is to evaluate the consolidation of the post-treated mixture of soil and ZVI-clay slurry at a scale that is more representative of the field.. In this regard, the research objectives include: (1) development of a modeling tool to predict the consolidation behavior of mixtures of sand and ZVI-bentonite slurry, (2) design and implementation of a large-scale laboratory apparatus to measure the consolidation behavior of mixtures of sand and ZVI-bentonite slurry, and (3) comparison of the predicted versus measured behavior. The overall goal is the development of a validated model that can effectively aid the remediation designer in predicting the site response to the application of the ZVI-Clay technology for future redevelopment, as well as providing large-scale consolidation data on representative mixtures of soil and ZVI-clay slurry.

[1] Research Assistant, Colorado State University, Department of Civil and Environmental Engineering, Fort Collins, CO 80523
[2] Professor, Colorado State University, Department of Civil and Environmental Engineering, Fort Collins, CO 80523
[3] Research Scientist, Colorado State University, Department of Civil and Environmental Engineering, Fort Collins, CO 80523