In Situ Solidification in Glacial Till Stratigraphy

Eleanor Beckwith (ebeckwith@brwncald.com) and
Marek Ostrowski (Brown and Caldwell, Upper Saddle River, NJ, USA)

Background/Objectives. In situ solidification (ISS) is a method of mitigating contaminant migration from source materials within the subsurface by creating a low-permeability, solid mass that encapsulates pollutants and significantly reduces their mobility. ISS is a common remediation technology due to its versatility, relatively low implementation cost and small environmental footprint. The ISS process consists of mixing subsurface materials in-place with a cementitious grout, typically composed of Portland cement, ground-granulated blast furnace slag (GGBFS), bentonite, and water. ISS is designed to achieve project performance criteria for the unconfined compressive strength (UCS) and hydraulic conductivity. The exact ratio of the reagents varies by site and depends on the site-specific physical and chemical properties of the subsurface materials. At most ISS sites, these materials consist of unconsolidated soil and large particles and/or debris resulting from urban fill and demolition of former on-site structures, which are typically removed prior to mixing. However, in cases where unconsolidated soil is nearly absent and the subsurface materials consist predominantly of large particles, the design of the grout mixture used must be modified to achieve the design properties of the solidified mass. This presentation will discuss an overview of ISS and an evaluation of a grout mixture to be used as part of the ISS process at a former manufactured gas plant (MGP) site located in New York. At this site, the subsurface materials consist principally of a heterogenous mix of glacial till and large demolition debris with very limited amount of soil in the matrix.

Approach/Activities. Results of pre-design investigation activities at the former MGP site indicated that the subsurface environment differed from those encountered at typical sites where ISS is conducted. A subsequent investigation into the site-specific implementation of ISS was conducted which included test pitting under slurry and evaluating the solidified mass core. These results showed that adequate encapsulation of the large particles was achieved, but the UCS and hydraulic conductivity of the ISS matrix were lower than expected. This was most likely due to the lack of the unconsolidated soil and the presence of large voids in the rubble material where the grout is expected to have dispersed during mixing. To meet the project performance criteria for the UCS and hydraulic conductivity, various grout mixtures were then tested in a laboratory. Soil was not included in the test mixes to simulate actual site conditions (i.e., very low content of unconsolidated soil in the subsurface). Aliquots were tested for viscosity and density of the liquid grout to assess pumpability, and for UCS and hydraulic conductivity to determine the ISS performance criteria.

Results/Lessons Learned. The laboratory study is currently underway; results are expected to be available at the end of 2017. These results and the final design will be used to assess the applicability of ISS to the atypical subsurface conditions and the correlation of the results of the laboratory studies and field-scale implementation. This presentation will discuss the conditions of the former MGP site requiring alternative ISS design considerations, results of the pumpability testing for the ISS implementation at the site, results of the solidified mass testing, their relationship, and ways to streamline similar projects.