An Overview of In Situ Stabilization/Solidification Design in Sediment Sites

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Background/Objectives. The U.S. EPA estimates that there are currently 545 active remediation sites with a sediment component across the nation. With cleanup costs reaching into the billions of dollars, new technologies that can deliver effective cleanup solutions at a lower cost than conventional cleanup methods are beginning to receive more serious consideration than ever. ISS has been a proven and successful technology for the remediation of both inorganic and organic contaminants in a variety of upland site conditions and constraints since the 1980s and has recently emerged in the past few years as a viable alternative for the remediation of contaminated sediment sites beyond traditional dredging/disposal, and capping remedies. Unlike upland sites, more dynamic nature of subaqueous sediment settings introduces additional challenges to ISS design process, including changes to the groundwater - surface water interaction at the site and changes to physical characteristics and geotechnical strength of the sediment.

This presentation will provide an overview of an ISS design process, its integration with the overall remedy, and ways to optimize the design under various site constraints. The presentation will conclude with lessons learned based on our experience from ongoing designs at various sites.

Approach/Activities. The design process often begins with identifying the areas of concern for the ISS treatment based on site characterization. Once the area of concern is defined, the site-specific performance requirements, both physical (e.g., unconfined compressive strength [UCS], hydraulic conductivity, and longevity) and chemical (e.g., reduction in cumulative mass release), are established to achieve the remedial action objectives. These performance requirements govern the appropriate mix design, which is a unique composition of reagents including Portland cement (PC), ground granulated blast furnace slag, supplemental amendments (e.g., oleophilic clay, activated carbon) and additives (e.g., superplasticizer, retardant, etc.). The proper ISS mix design is often identified through a site-specific bench-scale treatability and verified through a pilot-scale field implementation.

Because components of the remedy are interdependent, and none can be assessed in isolation, an iterative approach is often used to delineate limits of ISS treatment. The iterative approach includes: (i) defining the initial ISS footprint and thicknesses to address the COPCs; (ii) structural assessment of any marine structures in close proximity to ISS area; (iii) evaluation of post-remediation hydrogeological conditions; (iv) estimate post-remedy source material or dissolved phase COPC migration to surface water to inform the need for supplemental thin-layer cap; and (v) assessment of hydrodynamics, and sediment transport patterns in post-remediation conditions to ensure durability of the overall remedy over its life-time. This iterative approach is utilized to adjust the vertical and lateral limits of ISS until the overall remedy can achieve the remedial action objectives.

Results/Lessons Learned. Recent design projects have highlighted that site-specific performance criteria often governs the ISS mix design and approach on the treatability study to identify the proper mix design. Because of the factors only inherent to field implementation (e.g., surface water intrusion, degree of mixing, heterogeneity of the sediment), often a conservative approach in selecting the mix design from bench-scale treatability studies, and critical thinking of the construction sequencing is recommended. Additionally, our experience suggests that

integrating the various design components early in the design process often reduces the unexpected surprises in the field and facilitates more cost-effective design and implementation of a remedy that can achieve the remedial action objectives throughout its life time.