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Evaluation of chemical oxidation process on removal of hydrophobic contaminants in sediment for beneficial use in construction

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Background/Objectives. There is a growing recognition to find alternative solutions for stabilized dredged material that involves beneficial use of sediments including engineered fill or construction material, habitat restoration, elevation for coastal resiliency and brownfield projects. However, for this to be a viable option, the material must have favorable environmental characteristics (both chemically and geotechnically), and it is important that the inherent risks due to the presence of contaminants are reduced. Several ex-situ remedial technologies have been shown to reduce persistent organic pollutants (e.g., polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyl (PCB)] concentrations in soils and sediments including advanced liquid-solid oxidation processes (AOP. However, the applicability of these chemical treatment technologies for sediments containing varying levels of natural organic matter and multiple contaminant suites is not well known. The goal of this study is to investigate the feasibility of chemical oxidation of hydrophobic contaminants in sediments for beneficial reuse in construction. The application of AOP in reducing a contaminant load may enhance beneficial use placement construction opportunities in meeting regulatory requirements (including structural) not realized without treatment.

Approach/Activities.

The study involves direct application of both AOP & non-AOP (e.g., permanganate and Fenton's based oxidants) based chemical treatment process into sediments specifically for the removal of bulk sediment PAH. The study will monitor the effectiveness of treatment based on multiple experimental parameters including reagent type, dosage, and ancillary sediment parameters such as total organic carbon (TOC) that may influence the treatment efficacy. Furthermore, a select set of treated sediments would be evaluated for ex-situ stabilization experiments through controlled laboratory experiments by mixing the sediment with different types (e.g., Portland cement) and dosage of binders to minimize cracking and strength degradation.

Results/Lessons Learned.

Preliminary results from non-AOP based experiments show significant decreases in bulk PAH concentrations during treatment of site specific contaminated sediments. However, there was also concomitant removal of TOC resulting in relatively high dosage of oxidant relative to concentration of target contaminant. The study will also compare results of common chemical oxidation processes for reduction/increase of bulk and porewater concentrations of PAH, and potential release of trace metals to evaluate the optimal combination of chemical treatment. Based on the results, a preliminary techno-economic analysis will be presented to evaluate the balance between treatment costs and stabilized product benefits and targeted uses.