On-site, On-demand Contaminant Monitoring and Reduction for Dredging Operations by 3D printed Structures

Dredging Operations Environmental Research (DOER) Program

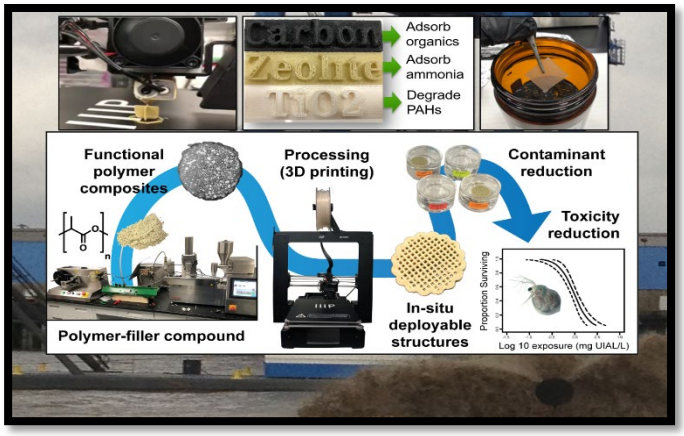
U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Focus Area

Risk Management

Problem

USACE requires innovative solutions to routine evaluations of dredged material (DM) contamination. There is need is for on-site (e.g., confined disposal facility, vessels), on-demand detection, sampling and sequestration of contaminants present in DM plumes and bedded sediment to proactively determine what may be released during operations, without continual need to transport the DM to the laboratory.



Study Description

The chemicals addressed include traditional (e.g., metals, hydrocarbons) and emerging (e.g., polyfluoroalkyl substances, or PFAS) DM associated contaminants using next generation passive sampling and remediation method development. Generation of customizable, 3D printable advanced material composites specific to traditional contaminants of concern (CoC) chemical classes addresses a near-term USACE need. Addressing emerging contaminant health concerns proactively addresses future mission impacts that are receiving priority for action by regulators and the public; this suggests USACE needs proactive rationale to (1) justify not including PFAS on CoC lists; or (2) potentially including PFAS on a case-specific basis. The project delivery team developed a solution to compound resins in 3D printable structures (DOER 19-13). However, current capability is lab-based and only focused on addressing one traditional CoC at a time. This effort expands capability to address multiple CoCs simultaneously. Higher and more effective loadings of resins will be accomplished by novel 3D printing methods and adsorption kinetics will be increased by advanced process controls. Focus will be given to scalability and field demonstration (CDF discharge or DM plume). Execution will be accomplished by 7 interrelated tasks: (1) compounding advanced adsorptive material feedstocks; (2) printing high surface area adsorptive geometries; (3) laboratory demonstration; (4) analysis of multifunctional adsorptive, destructive materials for passive sampling and remediation; (5) field demonstration; (6) transition roadmap for USACE districts to scale-up these multifunctional advanced material composites for on-site, on vessel deployment.

Products

FY22: Tech Note (TN): future of 3D printed passive sampler deployment; **FY23:** Journal Article (JA): adsorbing traditional and emerging contaminant mixtures; **FY24:** JA: 3D printed multifunctional materials for simultaneous chemical class adsorption; **FY24**: TN: road mapping demonstration and scalability to operations.

Summary

A customizable, fit-for-purpose monitoring technology resulting from this research will provide insight to down-select DM sites potentially needing remediation measures vs. areas where CoC bioavailability is of lesser concern. We will expand low cost 3D printing technology to be amenable to on-site, on-vessel, on-demand materials for remediation (adsorption, destruction) and monitoring to down select and reduce cost of analyzing traditional and emerging contaminants of concern and field deploy the technology to address scalability. USACE would realize cost savings by reducing: (1) imprudent evaluations; or (2) dredging to remove low risk materials.

Balancing operational and environmental initiatives and meeting complex challenges of dredging and dredged material placement in support of the navigation mission.

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