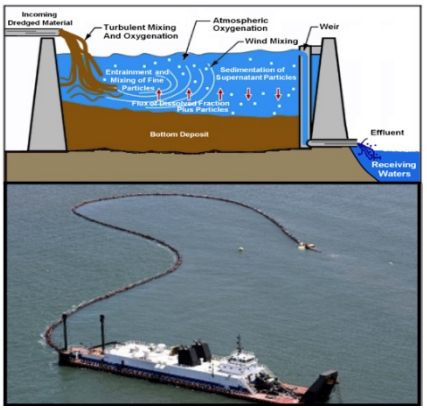
3D Printed Design for Remediation and Monitoring of Dredged Material

Dredging Operations Environmental Research (DOER) Program

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Focus Area

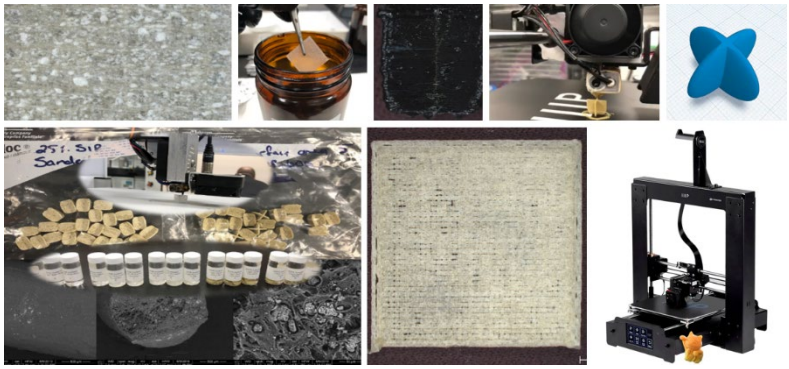
Risk Management



Problem

This research addresses the recurring issues of continual operational management of contaminated sediments for US Army Corps of Engineers (USACE) that delay decisions and The Mission to move Dredged Material (DM) in a timely manner and increases management cost. The management of DMs Contaminants of Concern (CoC) is dynamic as new dredges are designed and Confined Disposal Facilities (CDF) capacities and discharge composition change over time. To solve this dynamic and site-specific problem, research is needed to develop a rapid prototyping tool to make multi-functional materials for DM and CDF contaminant plumes.

Study Description



This effort will prototype new materials to reduce the fate, transport and bioavailability of multiple CoC in DM and deploy recoverable devices that contain both remediation capability and passive samplers to provide long-term monitoring of the efficacy of remediation measures. The first task is integration of activated carbon and resins into 3D printing thermoplastic feedstocks. The second task is use the novel feedstocks created in Task 1 to create high surface area geometries for remediation of contaminated DM elutriates and sediments. The third task involves 3D printed devices of varying gyroscopic buoyancy to contain strategically positioned passive samplers that can be deployed at different depths of DM plumes. The fourth task is a laboratory proof of efficacy microcosm study using USACE Harbor sediments and generating kinetics of sequestration of the CoCs. The fifth task involves field demonstration using the optimized 3D printed floatable remediation technologies and gyroscopic retrievable passive sampling devices.

Products

A conference presentation was presented at SETAC North America in November 2019 entitled, “3D printed design for remediation and monitoring of dredged material contaminants”. The conference presentation presented on both method development of incorporating sorptive materials into 3D printer filaments and the data for contamination remediation using the fabricated 3D printed materials. A Technical Note (TN) “Methods for Incorporating Contaminant Sorptive Materials into 3D Printer Filament”. A Journal Article (JA) “Efficacy of 3D printed geometries for mitigating metals and organics” will provide data and recovery of contaminants and give suggestions and links to online STL files and other method resources. The reporting of the efficacy of the contaminant monitoring technology will be demonstrated during operations in a TN titled “Field demonstration of deployable, 3D printed passive sampling devices at a USACE discharge site.” A digital library will be made available of all of the 3D print files for each of the deployable devices created for each of the contaminated dredging environments.

Summary

The benefit to USACE operations is greater dredging mission certainty in the face of regulatory requirements on discharges through rapid, targeted treatment and monitoring for CoCs in dredging plumes using materials that can be produced or even fabricated in the field. This allows the capability to rapidly deploy remediation and monitoring measures for unexpected discharge events made possible by 3D printing capability that eliminates the need to order materials and stop operations when waiting for part delivery. The seemingly limitless structural configurations and ability to create novel thermoplastic filaments for printing research tailored additives will provide this research effort with rapid and adaptive flexibility to overcome previous barriers.

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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