Next Generation Dredged Material Evaluation: Bioaccumulation on a Chip

Dredging Operations Environmental Research (DOER) Program

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Focus Area

Risk Management

Problem

Bioaccumulation testing is the costliest and most time-consuming component of the required testing conducted for the assessment of dredged material. The current suite of bioaccumulation tests requires large volumes of sediment (>50L) to be collected, shipped and processed under controlled conditions. In addition to the collection and transportation costs, the large analytical mass requirement for the standard test organisms introduces additional uncertainty and cost. Marine bioaccumulation test organisms are expensive and are field collected; this is problematic because they may not be available at the desired time of testing and may display varying levels of responsiveness due to variability in native condition or stress during collection and shipping. Finally, if any analysis fails (poor quality control, analyst error, etc.) the analysis cannot be repeated without similar amounts of sample to reprocess. At a minimum, bioaccumulation testing typically corresponds to $40,000 - $100,000 and in some cases up to $250,000 of a project's testing budget, contingent on the analyses of the project's contaminants of concern (CoCs). Consequently, reduction or elimination of bioaccumulation testing requirements using alternate low-cost approaches has potential to significantly reduce overall project costs. Substantial cost saving is expected to be achieved if the screening evaluation of bioaccumulation potential results in fewer dredged material requiring benthic bioaccumulation tests.

Study Description

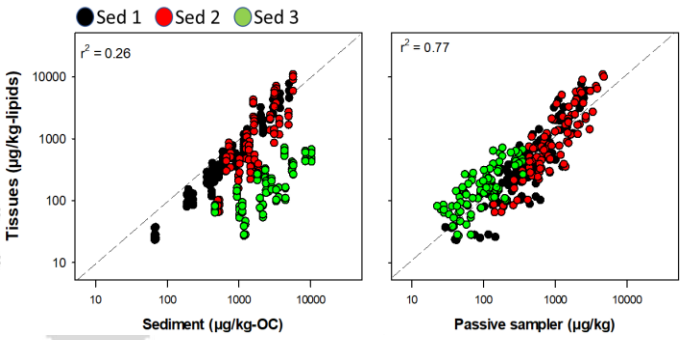
The proposed effort would determine the optimal experimental approach for bioaccumulation screening using polymer samplers and related devices for screening all bioaccumulation CoCs. Bioavailability will be evaluated using the following technologies: 1) ex-situ polymer sampling (e.g., polydimethylsiloxane (PDMS) and low-density polyethylene (LDPE) samplers) for deriving freely dissolved concentrations of hydrophobic organic compounds (HOCs) , 2) single-point Tenax extraction, a method recognized as robust by the USEPA and that has simpler and faster application to HOCs compared to polymer sampling, 3) diffusive gradient in thin-film (DGT) passive samplers as a tool to the bioaccumulation potential of metals and methylmercury, and 4) sediment porewater dialysis passive samplers, also known as "peepers" for measuring the concentration of inorganics in the sediment porewater. Alternate or additional technologies may be evaluated upon consultation with USEPA collaborators. The outcome of the bioavailability assessment will be evaluated using results of sediment bioaccumulation tests commonly used in dredged material evaluations. Reference sediment will be used as a point of comparison for decision-making.

Products

Planned products are a Technical Report summarizing the state of the science in the application of passive sampling technology for bioavailability assessment and applications as predictors of benthic bioaccumulation (year 1) and, webinar and/or video presentation summarizing the year 1 TR (year 2), ERDC standard operating procedures and journal article summarizing results of experimental work and providing the rational and summary guidance for applying passive sampling technology for bioavailability assessment in benthic bioaccumulation evaluations (year 3).

Summary

Bioaccumulation testing is the costliest and most time-consuming component of the required testing conducted for the assessment of dredged material. The proposed effort will establish robust approaches for bioaccumulation screening using polymer samplers and related devices for bioaccumulation CoCs. We will develop clear decision guidance that will indicate when bioaccumulation testing would be unnecessary and therefore accomplish substantial cost saving.



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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