Cost and Feasibility of Conventional and Active Sediment Capping

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South and Southwest

LSU

Rice  Texas A&M  Georgia Tech

- Research and Technology Transfer supported by EPA
  - Contaminated sediments and dredged material
  - Historically focused on in-situ processes and risk management
  - Unique regional (4&6) hazardous substance problems

- Outreach
  - Primarily regional in scope
  - Driven by community interests and problems
Cap Functions/ Design Objectives

- Physical isolation of sediments
- Stabilization of sediments
- Improve aquatic habitat
- Reductions in flux (elimination of direct bioturbation of contaminated sediments) to improve water quality and/or to maintain desired sediment concentrations
- Control of residuals (remaining inventory and dredging residual)
Potential of Active Caps

- Sand caps easy to place and effective
  - Contain sediment
  - Retard contaminant migration
  - Physically separate organisms from contamination
- Greater effectiveness possible with “active” caps
  - Encourage fate processes such as sequestration or degradation of contaminants beneath cap
  - Discourage recontamination of cap
  - Encourage degradation to eliminate negative consequences of subsequent cap loss
Active Capping Demonstration

The comparative effectiveness of traditional and innovative capping methods relative to control areas needs to be demonstrated and validated under realistic, well documented, in-situ, conditions at contaminated sediment sites

- Better technical understanding of controlling parameters
- Technical guidance for proper remedy selection and approaches
- Broader scientific, regulatory and public acceptance of innovative approaches
Anacostia River, Washington DC
# Project Participants

- **PI – Danny Reible, LSU & HSRC/S&SW**
- **Anacostia Watershed Toxics Alliance**
- **EPA SITE program/Batelle**
- **Sediment RTDF**
- **Laboratory Demonstration Studies**
  - Carnegie Mellon University
  - Hart-Crowser
  - Rice University
- **Field Program**
  - Horne Engineering
  - Sevenson Marine Contractors
  - EA Environmental Consultants
  - Electric Power Research Institute/PEPCO
  - University of Michigan
  - Cornell University
  - Ocean Survey
  - HydroQual
  - LSU
  - University of New Hampshire
  - Hull and Associates
  - LSU
Active Caps
Preliminary or Lab Assessment

- Seepage control
  - Aquablok
- Sequestration of hydrophobic organic compounds
  - Activated Carbon
  - Coke
  - Ambersorb
  - XAD-2
  - Organo modified clay
- Sequestration of metals
  - Apatite
- Encourage degradation
  - Bion Soil
  - Zero valent iron
Selected Active Caps and Goals of Field Program

- AquaBlok™ – w/EPA SITE program
  - Evaluate tidal seepage control
  - Evaluate potential for uplift during tidal range
- Coke
  - Evaluate PAH sequestration/retardation
  - Evaluate placement in laminated mat designed and built by CETCO
- Apatite
  - Evaluate metal sequestration/retardation
  - Evaluate effectiveness of direct placement
- Sand (for comparison)
Scale up - Conventional

- Laboratory experiments to define key processes and parameters
- Modeling to project to field time and distance scales
- Demonstration
  - Evaluation of adequacy of scale up
  - Influence of complicating factors
Capping Issues and Complications

- Long term containment of contaminants
- Erosion due to wind-driven waves or stream flow
- Influence of habitat on cap performance
- Ground water upwelling
- Mobilization of NAPL
- Gas ebullition
- Ice scour
- Sediment slope stability
- Cap placement limitations
Potential Habitat with Cap

Cap Layer

e.g. <5 ft below MWD

R. Davis
Seepage rates in Anacostia

Anacostia River SGD 9/10/03

Specific Discharge cm/d

Tide ft.

Time hrs.

AR3, AR1, AR2, AR4, AR5, AR6, Tide ft.
Sediment Camera Image – Anacostia

Bubble
Pilot Study Cell Layout
Composite Cap Design

Sand Layer

Active Layer

River Bottom
Observations on Placement (Tentative)

- **Intermixing**
  - 3-4” in softest sediment areas for sand cap and near-surface bucket release
    - Areas where undrained shear strength 10-25 lb/ft²
    - Minimal in other areas where undrained shear strength >40 lb/ft²

- **Uniformity**
  - Influenced most by intermixing in sand area
  - 3-6” likely minimum by surface bucket release
  - Winops system and operator experience critical for control of thin lifts
Selected Active Caps

Material Costs

- **AquaBlokk**
  - $170/ton material cost
  - $2.30/ft² material cost (2-4” layer)
  - ~$3.00/ft² material cost (3-6” layer- minimum achievable)

- **Coke**
  - $145/ton material cost
  - $0.11-$0.14/ft² material cost (~1/2” active layer thickness)
  - $1/ft² mat construction cost

- **Apatite**
  - $135/ton
  - $4.20/ft² (6” layer)

- **Sand (for comparison)**
  - $13.50/ton
  - $0.68 ft² (6” layer)
Selected Active Caps
Total Material Costs

- **AquaBlok (3-6” + 6” sand)**
  - $3.70/ft²
  - $33/yd²

- **Coke (mat + 6” sand)**
  - $1.80/ft²
  - $16/yd²

- **Apatite (6” + 6” sand)**
  - $4.90 /ft²
  - $44/yd²

- **Sand (12” layer)**
  - $1.40/ ft²
  - $ 13/yd²
Cap Placement Costs

- Demonstration approaches $200/\text{yd}^2$
- Large scale site (\(~1000\) acre)
  - $25/\text{yd}^2 + \text{materials}$
  - Mobilization/demobilization \(~$1/\text{yd}^2$
  - Cap placement \(~$10/\text{yd}^2$
  - Project Management \(~$2/\text{yd}^2$
  - Monitoring \(~$10/\text{yd}^2$
  - Miscellaneous \(~2/\text{yd}^2
    - Site Preparation
    - Construction Management
    - Design and Permits

- Sand capping cost \(~\text{Navigational dredging}$