Beneficial Use and Dredged Material Management – Graduate Course 610

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MODC - NJ DOT/OMR Dredging 101 Seminar
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www.wrdadcon.bnl.gov

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What Happens to Our Dredged Material?

1 75% Sand; grainsize distribution must be equivalent to existing conditions
2 Uses assume no decontamination
3 Uses assume clean or decontaminated

Sand
[>0.0625 mm]

• Manufactured Soil
• Aggregate
• Intermediate Landfill Cover
• Ocean Disposal
• Beach Nourishment
• Habitat Restoration/Creation
• Upland Fill
• Highway Construction

Clean
[<0.0039 mm]

• Manufactured Soil
• Ocean Disposal
• Landfill Final Cap
• Landfill Liner
• Upland Fill
• Nearshore Fill
• Brownfield Cover
• Habitat Restoration/Creation
• Highway Construction

Clay

Contaminated
[>0.0039 mm]

Silt
[<0.0625 mm]

• Manufactured Soil
• Ocean Disposal
• Landfill Final Cap
• Landfill Liner
• Upland Fill
• Nearshore Fill
• Brownfield Cover
• Habitat Restoration/Creation
• Highway Construction

• Upland Fill
• Brownfield Cover
• Habitat Restoration/Creation
• Nearshore Fill
• Manufactured Soil
• Highway Construction

• Confined Aquatic Disposal
• Confined Upland Disposal
• Nearshore Fill (with Capping)
• Landfill Cap (with Clean Cover)
• Brownfield Cap (with Clean Cover)
• Mine Reclamation

• Confined Aquatic Disposal
• Confined Upland Disposal
• Nearshore Fill (with Capping)
• Landfill Intermediate Cover
• Mine Reclamation
• Brownfield Cap (with Clean Cover)
• Decontamination and Disposal
Dredged Material is a Resource

- Hank Schlieper

• Develop Long-term Self Sustaining Enterprises in the Environmental Management of Dredged Material
  - E.A. Stern (in a dream)

• Environmental Manufacturing
  - W.S. Douglas (in a nightmare)
Without an adequate technical basis for decision making, the special interests that are always present will tend to dominate the process.

Of course there is never enough information or data to answer all questions - hence decision making in the presence of uncertainty.
Integrated Sediment Management Research vs. Applied/Directed

- Managers and policy makers seem to have difficulty motivating the scientific community to carry out the needed research, perhaps because it is perceived as to “too applied”
Similarly, researchers complain that they do not get a clear messages from policy makers as to what is needed and, furthermore, that the managers and policy makers do not seem to use much of the information scientists have already produced.

Integrated Approach to Sediment Management (org/inorg)

- Natural Attenuation
- Environmental Precision Dredging
- Capping
- Stabilization/Solidification
- CDFs/CADs
- Innovative Decontamination Technologies (non-thermal/thermals)
- In-Situ (Bioremediation)
USEPA, BNL, USACE WRDA 92,96,99
NJ MR Regional Sediment Decontamination Programs

• Demonstrate at the capacity of at least 500,000 cy/yr the decontamination of dredged materials from NY/NJ harbor with the creation of **marketable Beneficial Use End Products**
  - environmental manufacturing
  - treatment trains
  - low/ competitive costs ($29 cy)
  - $20 mill/ $20 mill
Sediment Decontamination (component) Fits Into a Matrix of Dredged Material / Contaminated Sediment Management, Environmental Restoration Scenarios Coupled with Economic Drivers for Re-Vitalization/Development using Beneficial Use products Derived from Dredged Materials for Ports and Waterways
NY/NJ Sediment Decontamination
Program Integration Teams

• **WRDA**
  - USEPA Region 2
  - Brookhaven National Laboratory - DoE
  - USACE NY District
    • WES
  - Montclair State University
  - Rutgers University
  - Rensselaer Polyt. Inst.

• **DOT - NJ Office of Maritime Resources**

• **Collaborations**
  - USEPA GLNPO
  - Port Authority NY/ NJ
  - Michigan DEQ
  - USACE Seattle Dist.
  - WA State DNR
  - Venice Port Authority
  - Technology Development Firms
BioGenesis Bench-Scale Apparatus
BioGenesis Pilot-scale Demonstration - Kearny, NJ
BioGenesis Technology Implementation
Yokohama, Japan
Post Treated Manufactured Soil

- Feasibility has been widely investigated
- USACE (WES), WRDA, State and academia studies
- Various qualities and formulas require from 30 to 40% sediment
Potential Uses of Modified Final Product

- Top Soil/Potting Soil
- Compost
- Finish Grading Material for Construction
- Cap or cover materials for landfills
- Restoration Material
Finished Mf Soil from BG Pilot Project
• Dredged Material Replacement of Mineral Elements in Cement Production

- Limestone
- Chalk
- Clay
- Shale

Percentage by mass

[Diagram showing percentages of SiO₂, Al₂O₃, Fe₂O₃, and CaO for Dredged Material and Portland cement slurry.]
Cement-Lock Demo Plant
Identified Use of Cement Produced by Cement-Lock

- General construction for sediment processing stakeholders (e.g., state road construction, federal construction projects, port authorities, USACE, etc.)
- Filling / grouting of underground tanks at DOE / DOD sites
- Soil conditioning at landfills operated for stakeholders
- Sediment stabilization processes that currently use portland cement
- Construction of retention walls in Pennsylvania mines
Jay Cashman Inc. / Upcycle Aggregates

• **Use of Existing Infrastructure:**
  - Rotary Kiln for Light Weight Aggregate
  - Dredged Material Replaces Shale
    • Reduces Blasting/Dust

• **Process Configuration:**
  - Dredge/Dewater (belt filter press)/Pelletize
  - Transport by Barge, Rail, Truck
  - Process at Existing LWA Rotary Kiln Facility
  - LWA Manufacturing to Market
HarborRock General Process Description

River clay (mined sediments), are received on a tip floor via a loader or conveyor. The clay material is screened, dried, ground and extruded into pellets. The green pellets are dried, then feed into a rotary kiln and fired. The lightweight aggregate is then cooled, graded and shipped to the end user.
Asphalt paving
Structural concrete
LWA has been used worldwide for more than 100 years in:

Masonry block
Sediment is Exposed to the High-Temperature Plume of a Plasma Torch

- Air is passed through plasma torch and heated to >5000°C
- Partially dewatered sediment is injected in front of plasma torch plume
- Organics are quantitatively combusted
- Mineral phases are fused into molten glass
- Fluxes (CaO, Na₂O) may be added to modify the properties of the final glass product
Vitrified Sediment Beneficial Use
Applications

- Architectural Tile Manufacture
- Glass Fiber (Rock Wool Insulation)
- Sandblasting Grit (Black Beauty®)
- Roadbed Aggregate (“Glasphalt”)
- Roofing Granules (Shingle Manufacture)
- Recycle Glass Cullet
- Integrated Plasma Gasification
Clean Sand -
Beach Nourishment
Clean Sand
Beach Nourishment
Landfill Closure
Clay
Rock – Artificial Reef Habitat
Clean Silt/Clay
Oyster Reef Restoration
Clean Silt/Clay
New Habitat
Four years later
Habitat Creation
Sediment Ecosystem Restoration

Figure 6

Kearny Point Wildlife Refuge
Conceptual Plan

[Address and contact information]
Renewable CDF

• Construct dewatering and treatment facility(s) with beneficial use applications adjacent to CDF

• CDF renews itself by having continuous capacity by recycling the dredged material
Details of A Renewable Confined Disposal Facility

- Contaminated Sediment
  - Screening
  - Renewable Confined Disposal Facility
  - Treatment System
    - Pathogen Sterilization
    - Sewage Sludge
      - Recycled Glass Grind Glass to Sand
      - Recycled Yard Waste Compost
      - Recycled Paper Pulp

- Top Soil
- Environmental Restoration
- Select Fill
- Flowable Fill
• **Markets for Beneficial Use Products**

  - Encourage use in DOT, Port Authority, Federal and State Highway / Construction Projects

  • Regional Markets
  • Over-saturation of product
  • State Soil Criteria (non/residential)
  • Geo-technical (ASTM) requirements