Geotube Technology for Residuals and Biosolids Management
Introduction

Outline

– Geotextile Container Introduction
– Chemical Conditioning Programs
– Feasibility Evaluations
– Online Optimization
– Case Studies
What is a Geotextile Container?

- Geotextile Containers offer a high volume, high flow containment option, for dewatering and consolidation of hydraulically dredged material.
Use of Geotextile Containers

Geotextile Containers Can be used for

– Coarse-grain sediments
– Fine-grain sediments
Coarse - Grain Sediment

- Geotextile Containers have been used to form berms, stabilize beaches, prevent erosion, form levees, peninsulas, groynes, and other manmade structures.

- Offer shear strength for landfill cap-in-place projects.
Fine-Grained Sediments

• Technological advances in the application of dewatering chemistry and Tube construction allows for containment of solids and contaminants, while providing a clean, safe effluent of water that can be returned to the receiving system.

• Geotextile Containers can now be used to dewater and contain Metals, Dioxins, PCBs, PAHs, Pesticides, Clays, Silt, and other organic materials.
Chemical Conditioning Optimization

What are my dewatering objectives?

- Containment/Consolidation
- Effluent Water Characteristics
- Time to dryness
- Total Dryness

What are my chemical conditioning choices?

- Organic Flocculents
- Organic Coagulants
- Inorganic Coagulants
- Hybrid Chemistries
Common Thread
Chemical Conditioning

\[
\text{acrylamide}
\]

\[
\begin{array}{c}
H_2C \\ \text{CH} \\ C \\ \text{O} \\
\text{NH}_2
\end{array}
\]

\[
\begin{array}{c}
\text{CH}_2 \\ \text{CH} \\ \text{C=O} \\
\text{NH}_2
\end{array}_n
\]
Polymer Selection

Coagulation or Charge Neutralization – “like getting magnets to come together”

• Cationic
• Anionic
• Nonionic

Flocculation – “to sweep the magnets together into a pile”

• Molecular weight
Principles of flocculation
Flocculation

Before Flocculant is added

After Flocculant is added
“Traditional”
Product Selection
“Traditional” Product Selection

Charge density vs. Molecular weight diagram showing different product selections based on molecular weight and charge density. The diagram includes various product categories such as 90A-low, 90B-medium, 80B-medium, 70A-low, 60A-low, 50A-low, 40A-low, 20A-low, 10A-low, and 70C-high, 60C-high, 50C-high, 40C-high, 30C-high.
Advancements in “Site-specific” Product Selection

Molecular weight

Charge density

- 90A-low
- 90B-medium
- 80B-medium
- 70C-high
- 60A-low
- 60B-medium
- 50A-low
- 40A-low
- 40B-medium
- 40C-high
- 30C-high
- 20A-low
- 20B-medium
- 10A-low
- 10C-high

70A-low
69A-low
68A-low
67A-low
66A-low
65A-low
64A-low
63A-low
62A-low
61A-low
60A-low

WaterSolve LLC
Polymer Selection

Polymer Forms

• Dry
• Emulsion
• Solution
Chemical Optimization

Factors Affecting Product Selection

Make-down requirements
Feed equipment requirements
Handling
Lead times/availability
Shelf life
Storage/Use Environment
Aquatic Toxicity
$/lb

Once determined:
Must evaluate those products on the bench and in small scale studies.
Jar Testing “what to look for”

- Release of free water
- Water clarity
- Floc Appearance
- Water release rate
- Dose optimization
- Filtered water targeted constituents removed
“Site-specific” chemical conditioning program

- Identify charge density, molecular weight, and structure of optimal chemistry through bench testing
- Manufacture the chemistry
- **Test chemistry in Performance Trials (Hanging Bag Test or GDT)!**
“What to look for in our Performance Trials”

- Timeline to target dryness
- Filtrate quality
- Volume released
- Conditioning efficiency & effectiveness

➢ Provides operational data
➢ Time to dryness and final outcome predictions can be made
GDT Test

Collect samples of the sludge material to be dewatered.
GDT Test

Pour all of the collected sludge into a 50 gallon container.
Mix polymer thoroughly with the collected sludge until a floc forms.
GDT Test

Pour the sludge into the GDT bag.
GDT Test

Lift the stand pipe slightly to facilitate initial flow into the bag. Continue adding sludge until it reaches the mark on the stand pipe indicating 1 psi.
GDT Test

Collect, measure, and analyze the effluent water draining from the test unit.
GDT Test

After the test bag dewatered, a sample of sludge can be collected to determine moisture content and percent dewatered solids. This can help to predict results in a full scale project.
Online Optimization Considerations:

- Mixing energy/Shear energy
- Slurry flow rate
- Water flow rate, water pressure
- Make-down contact time
- Density (watch out for sand) or Flow meter Control of Feed equipment
- Pre or Post-dilution water in the slurry
Pilot Scale Test

Smaller Geotextile Containers can simulate operational conditions when space, time, and/or budget considerations apply.
Larger scale pilot tests can also be used (if space and budget allow) to provide very detailed information.
Pilot Scale Test – Deliverables

- Filtrate quality
- Dewatering rate
- Consolidation
- Dosing and dose control
- Chemistry injection points
- Dilutions of slurry
- Chemical use costs
- Time to dryness
- Total dryness
- Other operational parameters to aid in full scale estimators
Use Software for Predictability

Use Software Programs to Predict Quantity of Geotextile Containers

Geotube® Estimator

English Units Input - Known Volume

Version 7.0
Licensed to: Master Copy 8-2007

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Large Project Anywhere</th>
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<tbody>
<tr>
<td>Location:</td>
<td>New York</td>
</tr>
<tr>
<td>Contact:</td>
<td>Bob Phaneuf</td>
</tr>
<tr>
<td>Date:</td>
<td>4/8/2008</td>
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<tr>
<td>Type of Material:</td>
<td>Contaminated Sediments</td>
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<table>
<thead>
<tr>
<th>Input</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>Volume</td>
<td>150,000 Cubic Yards</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.40</td>
</tr>
<tr>
<td>% Solids In Place</td>
<td>20.0%</td>
</tr>
<tr>
<td>% Solids During Pumping</td>
<td>8.0%</td>
</tr>
<tr>
<td>Target dewatered % Solids</td>
<td>55%</td>
</tr>
<tr>
<td>% Coarse grain &amp; sand*</td>
<td>3.0%</td>
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</table>

* % Coarse grain & sand is removed from the calculation for volume reduction due to dewatering and added back in at the end in required Geotube® volume.

<table>
<thead>
<tr>
<th>Output</th>
<th>Units</th>
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<tbody>
<tr>
<td>Total Volume Pumped</td>
<td>76,504,446 Gallons</td>
</tr>
<tr>
<td>Wet Volume per day</td>
<td>2,880,000 Gallons</td>
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<tr>
<td>Wet Volume per day</td>
<td>14,257.4 CY</td>
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<tr>
<td>Total Bone Dry Tons</td>
<td>26,803.6 Tons</td>
</tr>
<tr>
<td>Estimated Pumping Days</td>
<td>21.3 Days</td>
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<tr>
<td>Estimated Dewatered Volume</td>
<td>51,797.5 CY</td>
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<tr>
<td>Estimated Dewatered Weight</td>
<td>48,733.9 Tons</td>
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</tbody>
</table>

Production:

- Pumping Rate (GPM): 2,500
- Hours per Day: 24
- % Efficiency: 80%

<table>
<thead>
<tr>
<th>Estimated Geotube® Quantity:</th>
<th>Foot</th>
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<tbody>
<tr>
<td>Circumference X Pumping Height</td>
<td></td>
</tr>
<tr>
<td>30' X 6.5'</td>
<td>25,023</td>
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<tr>
<td>40' X 7.0'</td>
<td>15,987</td>
</tr>
<tr>
<td>45' X 7.0'</td>
<td>13,704</td>
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<tr>
<td>60' X 7.5'</td>
<td>6,993</td>
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<tr>
<td>75' X 8'</td>
<td>6,541</td>
</tr>
<tr>
<td>90' X 9'</td>
<td>4,986</td>
</tr>
<tr>
<td>120' X 9'</td>
<td>3,548</td>
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For MDS Applications:

- Legal Hauling Capacity: NA, Tons

<table>
<thead>
<tr>
<th>Estimated MDS Geotube® Units:</th>
<th>Each</th>
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<tbody>
<tr>
<td>MDS Dimension</td>
<td></td>
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<tr>
<td>22.5' X 22'</td>
<td>#VALUF!</td>
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Simulator Programs

Use SIMULATOR Programs to offer
- Dimensions
- Volumes
- Stresses.
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