Bench Scale and Field Observations of Geotextile Flow and Dewatering Characteristics

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Purpose of Geotextile Tubes

- Dewatering
  1. Volume reduction
  2. To return water to source sludge free

- Coastal preservation and protection
  1. Breakwaters
  2. Groins & Jetties
  3. Dune Cores
  4. Land/Marsh Creation

Pre-Summary

- The dewatering rates are dependent on the type of fabric used, polymer and size of tube.
- To achieve an indication of what the field dewatering performance may be, a cone filter test is used.
- The use of higher flow rate fabric in geotextile tubes allows dredging contractors to improve their efficiencies and reduce the quantity of tubes required.

The Geotextile Tube

- Large tubes between 30' – 150' (9.1 – 45.7 m) - in circumference
- Made of high strength woven geotextile fabric
- Used for sediment and sludge dewatering
- Also used for coastal protection

Geotextile Tubes for Dewatering

- Used for dredging operations
- Proven technology for the passive dewatering of sediment and sludge
- Slurry is treated with a chemical flocculent if it contains fines or organics
- Proper polymer treatment allows for you to get the best dewatering performance out of the tubes

Dewatering Applications

- Water Treatment Sludge
- Wastewater Sludge
- Industrial
- Mining Sludge
- Food Processing Sludge
- Animal Waste
- Hydrocarbon Sludge
- Marine Sediment (Silts)

Dewatering Process

- Starts with the dredging process
- Different types of dredges may be used depending on sediment being removed
- Dredged material pumped into geotextile tube
- Material is dewatered over a 2 – 4 week period
- After dewatering, material is hauled away


Dredge


Polymer


Dewater

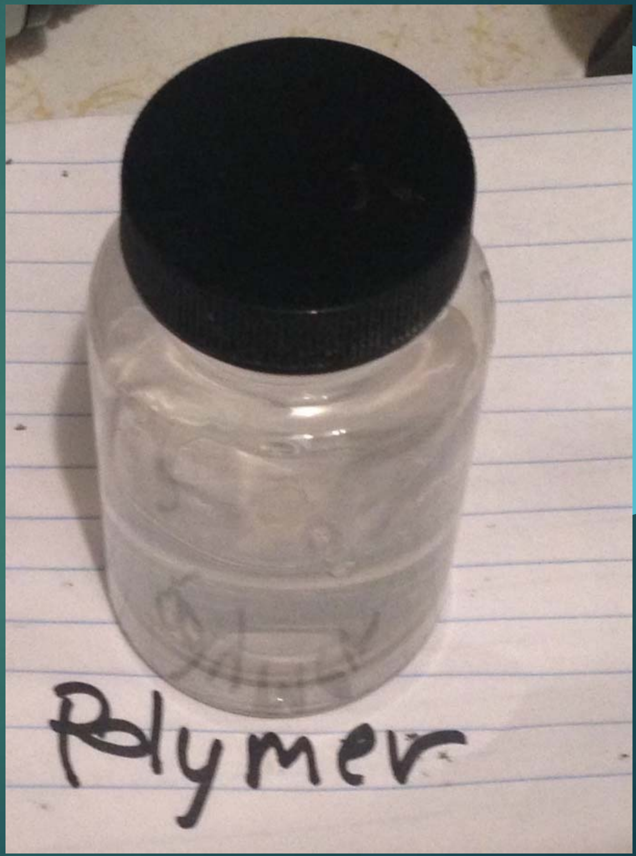

Remove

Dewatering Performance Testing
(Previous Investigations)

- Testing of 3 different slurries not treated with polymer.
- Used a vacuum filtration test
- This study from 2000 found that the fabrics tested all had acceptable retention and filtration results
- The average flow rate during the tests did not follow any trends based on the fabrics used.

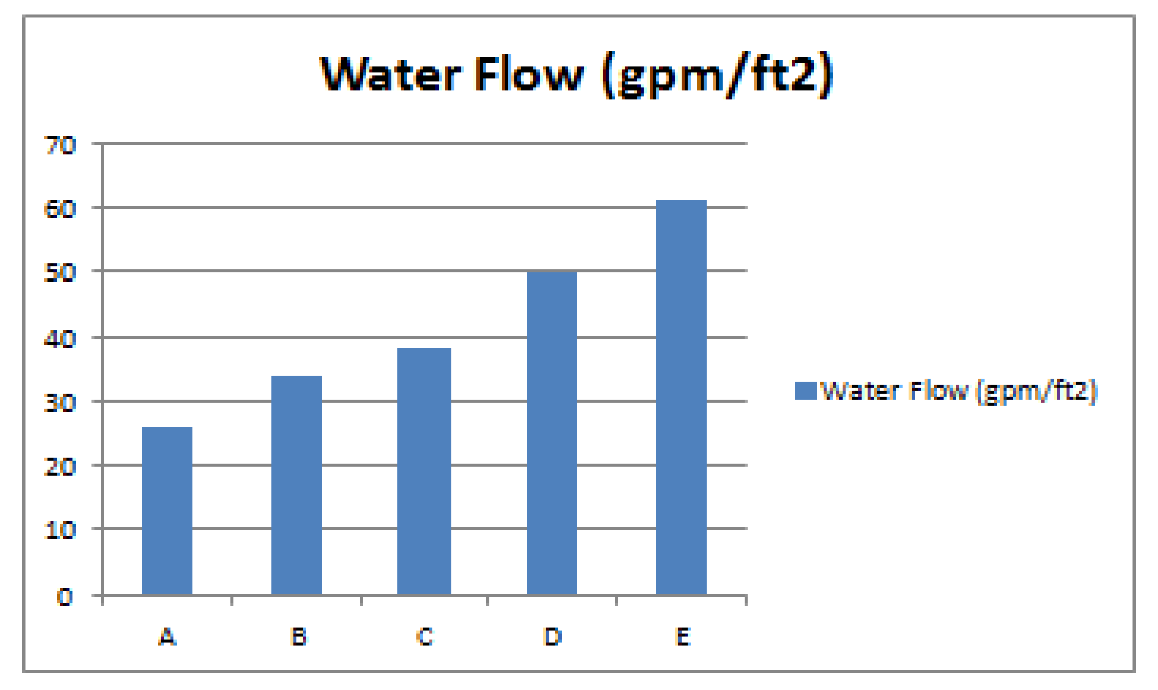
Dewatering Performance Testing
(Previous Investigations - continued)

- Study with Tully Silt with and without polymer treatment.
- Pressure filtration test was used.
- Of the geotextile tube fabrics tested, the woven polypropylene fabric has fastest dewatering rate of all when the slurry was treated with polymer.
- Nonwoven fabrics and composite fabrics dewatered slower than woven fabrics when treated slurry was tested.



Fabrics & Flow Rates Used in Study

- 5 different fabrics used:
- Fabric A: Sand colored with lowest flow rate
- Fabric B: Black fabric
- Fabric C: Sand colored with flow rate similar to typical dewatering tube
- Fabric D: Sand colored with high flow rate
- Fabric E: Sand colored with ultra-high flow rate



Note: 1 gpm/ft^2 + 40.746 $l/m/m^2$

Lab Testing

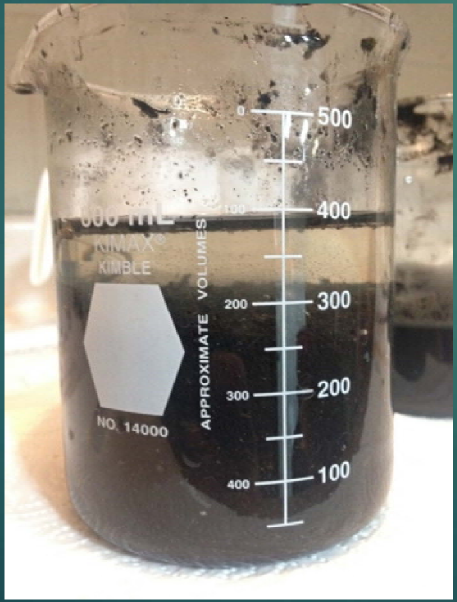
- Testing the Sample from Jackson, Mississippi job site
- Testing the Dewatering Rate for each fabric
- A cone filtration test used
  1. Modified time to filter test
  2. Simple and cost effective way to predict field conditions
- Fabrics cut into two sets of 12 in. x 12 in. (30.48 cm x 30.48 cm) squares to create cone-like shapes

Lab Testing (Continued)

- 200 ml sample taken for each
- 4 g of sample spread on pad for moisture balance test
- Sample then diluted with 200 ml water
- 4 ml of 0.5% HyChem HH 909 added in 1 ml increments
- The 400 ml of diluted sludge was poured into the fabric cone into graduated cylinder
- Measured the volume of filtrate at different time intervals

Lab Testing Completed

- Allow samples to drain for 24 hours
- Measured remaining water
- Completed process twice for all 5 fabrics



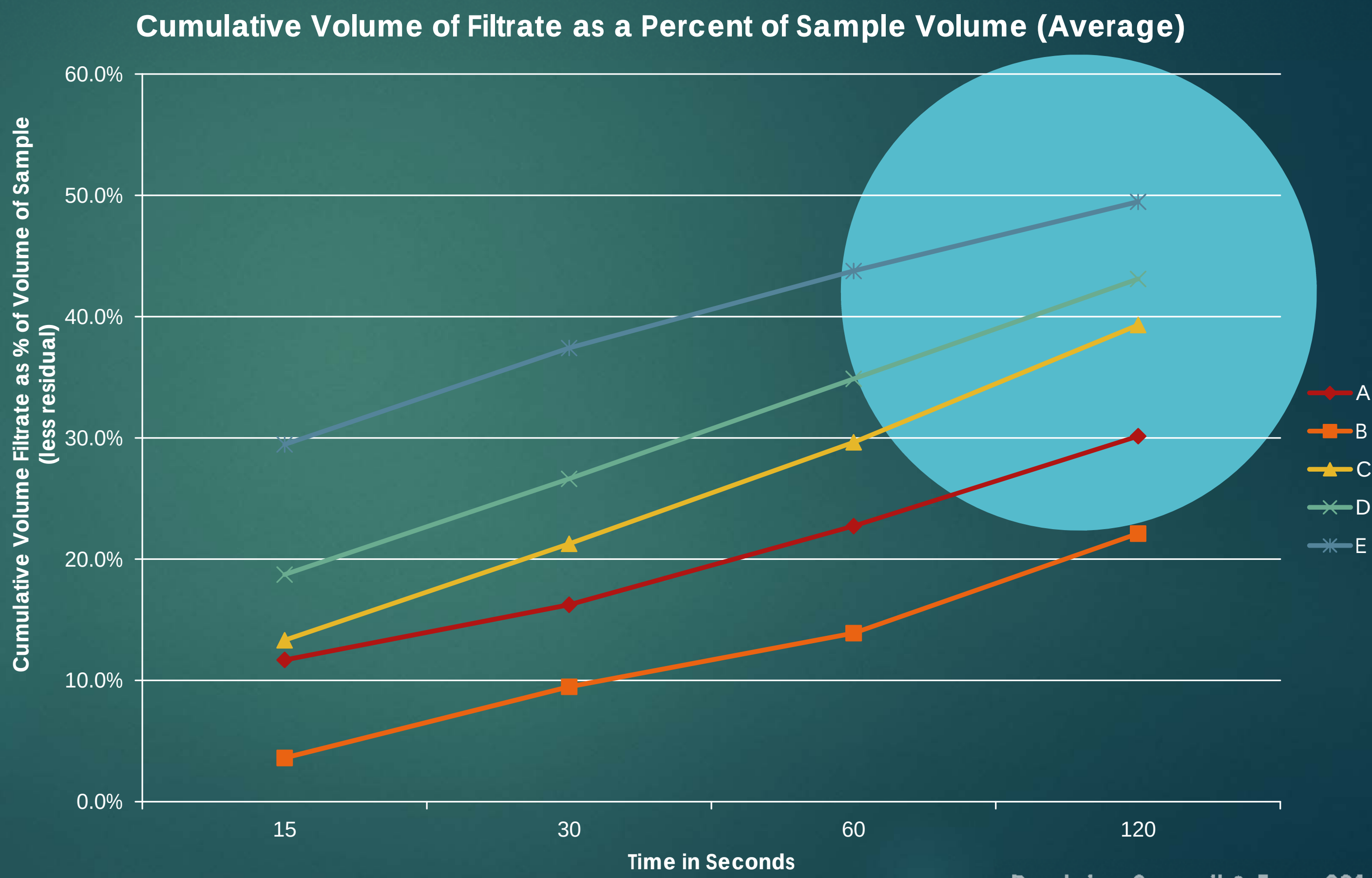
Analysis of Data

Sample	Initial Sample Volume (mL)	Initial Sample % Solids	Diluted Volume (mL)	Diluted Weight (g)	Diluted Solids %	Volume of Filtrate: 15 Seconds (mL)	30 Seconds (mL)	1 Min (mL)	2 Min (mL)	Weight Residual in Beaker of Diluted (g)
Avg. A	200	21.97%	400	430.3	4.95%	45	62.5	87.5	116	15.1
Avg. B	200	21.97%	400	419.1	5.90%	15	37.5	55	87.5	4.3
Avg. C	200	21.97%	400	425.1	8.38%	55	82.5	115	152.5	12
Avg. D	200	21.97%	400	419.3	7.85%	77.5	105	137.5	170	5.6
Avg. E	200	21.97%	400	413.2	7.99%	120	147.5	172.5	195	5.8

Sample	Volume Retained Between 2min - Final (mL)	% Solids Final	Total Volume of Filtrate (ml)	% of volume 15 sec	% of volume 30 sec	% of volume 1 min	% of volume 2 min	Final (volume filtrate as percent of total)
Avg. A	95	40.10%	211	11.7%	16.2%	22.7%	30.1%	54.8%
Avg. B	130	35.88%	217.5	3.6%	9.5%	13.9%	22.1%	55.0%
Avg. C	72.5	35.82%	225	13.3%	21.3%	29.6%	39.3%	58.0%
Avg. D	65	39.16%	235	18.7%	26.6%	34.9%	43.1%	59.6%
Avg. E	45	38.94%	240	29.5%	37.4%	43.8%	49.5%	60.9%

Lab Results

- Filtrate percentage collected in beakers during dewatering cone-testing for each fabric



Jackson Case Study

- Jackson, Mississippi
- At full scale project site, field measurements were made of dewatering rate
- Fabric “D” used
- Flint Dewatering Tubes used to dewater biosolids
- Cationic polymer used
- Total of 228 geotextile tubes used
- Tubes were 90’ (27.43 m) circumference with varying lengths

Jackson Case Study (Continued)

- Active rate of dewatering was estimated by pumping sludge into the geotextile tube via dredge
- Flow rates were monitored using an Endress & Hauser 55S in-line magnetic flow meter at 25 ft (7.62 m) intervals
- During process tube was set to dewater for 12hrs after pumping completed
- Holding capacity of tube averaged in excess of 2.5 dry tons / linear ft (7.45 metric tons/linear meter)

Pump Time (Hr.)	Ave. Flow Rate (GPM)	Total Pumped (Gal)	Total Retained (Gal)	Dewatering Rate (GPM)
1	1145	68,400	9896	975
2	1138	136,560	20735	965
3	1136	204,480	28745	976
4	1135	272,400	39113	972
Average	1137			972

Note: 1 gallon = 3.79 liters, 1 gpm = 3.79 l/min

Lab and Field Solids Percentage

- Percent Solids Averages:
  - Field: The average percent solid for the tubes used in the field analysis was in excess of 34%.
  - Lab Fabric D: The average percent solids for Fabric D was 39.16%

Recap

- Higher flow rate fabric yields faster dewatering rates.
- Cone filter test is indicative of what will be experienced in the field.
- The use of higher flow rate fabric in geotextile tubes allows dredging contractors to improve their efficiencies and reduce the quantity of tubes required.

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Acknowledgement of Project Team

- Denali Water (Formerly Terra Renewal)
- Industrial Technologies/CSI
- Flint Industries
- HyChem
- CDM Smith
- City of Jackson
- Geosyntec
- Others

Georgia Southern University

- The Allen E. Paulson (AEP) College of Engineering and Information Technology (CEIT) at Georgia Southern University started operations on July 1, 2012.
- The college offers both undergraduate and graduate degree programs.

  1- At the undergraduate level, the college offers the Bachelor of Science degree programs in Civil Engineering, Computer Science, Construction, Electrical Engineering, Information Technology and Mechanical Engineering.

  2- At the graduate level, the college offers the Master of Science degree programs in Applied Engineering and Computer Science.