Research Update on Compost BMPs used for ES&P Control

Britt Faucette, Ph.D.
Research Ecologist/ Director R&D
OUTLINE

• How & Why it works

• Research: Compost ECBs

• Research: Compost Filter Socks/Berms

• Take Home Messages
Erosion Control - ‘Prevention’

VS

Sediment Control – ‘Treatment’
Filter Media = Sediment Control

Growing Media = Erosion Control

Designed for Optimum Filtration & Hydraulic-flow

Designed for Optimum Water Absorption & Plant Growth
Specs/Certification is Key!

Training → Certification

Specifications

Performance Testing → Certification

Certification
PART I - Erosion Control

‘Soil Erosion Prevention’
EC/Slope Stabilization uses Growing Media

Compost **Storm Water** Blanket?

**Designed to:**
1) dissipate energy of rain impact;
2) hold, infiltrate & evaporate water;
3) slow down/disperse energy of sheet flow;
4) provide for optimum vegetation growth
Evaluation of Storm Water from Compost and Conventional Erosion Control Practices in Construction Activities

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Dept. of Biological & Agricultural Engineering¹, Institute of Ecology²,
The University of Georgia, Athens, GA
Evaluate the short and long term effects of compost compared to silt fence and hydroyseed on storm runoff, soil erosion, nutrient loss, vegetative growth characteristics and soil quality.
Experimental Design

- Blankets (1.5 in) & Filter Berms (1’ x 2’)
- Hydroseed applied by local professional
- DOT certified Class A silt fence
- Seeded w/ bermuda grass @ 20 lbs/ac (GDOT spec)
- 10% slope (cleared & graded)
- Plot size = 3’ wide x 16’ long
- Rainfall simulation = 3.1 in/hr for 1 hr = 50-yr/1-hr return for Athens, GA – worst case scenario
- 3 Storms = immediately after treatment application, 3 months, 12 months
- Soil sampling = day 1, 6 months, 18 months
- No supplemental irrigation
Vegetation Cover

The graph shows the vegetation cover over time for different treatments: Compost, Hydroseed, and Bare Soil. The x-axis represents the treatments, and the y-axis represents the percentage cover (% Cover). The covering is measured at 3 and 12 months.

- **Compost** treatment shows a slightly higher cover compared to Hydroseed and Bare Soil at both 3 and 12 months.
- **Hydroseed** treatment has a significantly higher cover at 12 months compared to 3 months.
- **Bare Soil** treatment shows the lowest cover for both 3 and 12 months.

The bars are labeled with letters: 'a' and 'b', indicating significant differences in coverage.
Invasive Weed Cover

*Weed Cover & Biomass positively correlated (r>0.85) to high inorganic N*
Average Elapsed Time to Runoff Start & Peak Flow

Treatments

- Compost #3
- Compost #4
- H-seed/Silt Fence
- Bare Soil

**Runoff Start**

- Compost #3: a
- Compost #4: a
- H-seed/Silt Fence: de
- Bare Soil: e

**Runoff at Peak Flow**

- Compost #3: a
- Compost #4: a
- H-seed/Silt Fence: b
- Bare Soil: b
Runoff Volume (mm)

Compost ECB, Hydroseed, Bare Soil

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Reduced</th>
<th>3 mo</th>
<th>Reduced</th>
<th>1 yr</th>
<th>Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>CECB</td>
<td>33</td>
<td>21%</td>
<td>8</td>
<td>83%</td>
<td>25</td>
<td>39%</td>
</tr>
<tr>
<td>Hydroseed</td>
<td>34</td>
<td>19%</td>
<td>26</td>
<td>43%</td>
<td>31</td>
<td>24%</td>
</tr>
<tr>
<td>Bare Soil</td>
<td>42</td>
<td></td>
<td>46</td>
<td></td>
<td>41</td>
<td></td>
</tr>
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</table>
Runoff Rate @ Peak Flow

<table>
<thead>
<tr>
<th>Treatment</th>
<th>3 months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compost #1</td>
<td>0.005</td>
<td>0.006</td>
</tr>
<tr>
<td>Compost #3</td>
<td>0.005</td>
<td>0.006</td>
</tr>
<tr>
<td>Hydroseed</td>
<td>0.015</td>
<td>0.016</td>
</tr>
<tr>
<td>Soil</td>
<td>0.020</td>
<td>0.021</td>
</tr>
</tbody>
</table>
Summary: Storm Runoff

Compost ECB vs Hydroseed

✓ Some compost ECBs produced NO runoff
✓ No runoff = little/no erosion (from transport)
✓ Greater time until start of runoff = no runoff for small & medium storm events
✓ Less runoff = smaller storm water management ponds/design areas = $$$$$$
Summary: Total Solids Loss

Hydroseed/silt fence vs Compost system for 3 storm events

- Day 1 = 308 & 136 g/m²
- 3 mo = 220 & 13 g/m²
- 1 yr = 15 & 14 g/m²
Nitrate-N Load

Compost #3
Compost #4
Hydroseed #1
Hydroseed #2
Soil

Day One
Three Months
Twelve Months

mg/m²
Diss. Reactive P Load

![Graph showing Dissolution Reactive P Load over different treatments and time periods. The x-axis represents different treatments and the y-axis represents the mg of dissolution. There are bars for Day One, Three Months, and Twelve Months.](image_url)
WHAT IS THE TAKE HOME MESSAGE FROM THIS STUDY?
Compost Blanket Particle Size & Straw Mulch w/ PAM Affects on Water Quality, Water Quantity & C Factors

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The University of Georgia

Funding assistance

USDA

Filtrexx\textsuperscript{1}
Objectives:

- Evaluate affect of particle size distribution on performance of Compost ECBs
- Compare performance of Compost ECBs to Straw Mulch w/PAM
- Evaluate performance of flocculants added to Compost ECBs for sediment reduction
- Determine RUSLE Cover (C) Factors for all treatments

Parameters:

Storm Water Quality & Quantity: TS loading, TSS loading, Turbidity, N & P loading, runoff volume, peak runoff rate, time to runoff commencement & peak flow

Vegetation: % cover & biomass of weeds and EC grass
Rainwater Absorption

Note: Straw w/ PAM is GA DOT standard practice

% of Rainwater

Min. to Runoff Commencement

Straw/PAM

0 10 20 30 40 50 60 70 80 90

Overs

Compost

%
% Reduction of Storm Water Runoff

Note: Straw w/ PAM is GA DOT standard practice

- Straw/PAM
- Overs
- Compost

Runoff Volume  Peak Flow Rate
Turbidity (NTU) during Storm #1

Note: Straw w/ PAM is GA DOT standard practice
WHAT IS THE TAKE HOME MESSAGE FROM THIS STUDY?
PART II - Sediment Control

‘Storm Water Treatment’
Filtration Devices use Filter Media
What’s in that Sock?  
3-Way Filtration

• **Physical**
  - Traps sediment in matrix of varying pore spaces and sizes

• **Chemical**
  - Binds and adsorbs nutrients/hydrocarbons in storm runoff

• **Biological**
  - Degrades various compounds with bacteria and fungi

Filtrexx Products 2004
Silt Fence Is a Single Membrane and Functions as Mini *Sediment* Detention Pond

- Designed to pond water
- Suspended solids smaller than filter fabric pores
- Only functions once clogging begins

**US EPA/NPDES**
- Clay removal = 0-20%
- Silt removal = 50-80%
- Sand removal = 90%

Filtrexx Products 2004
Filter Socks Act as a 3 Dimensional *Filter*

- Designed to flow water faster
- Mix of particle sizes (SPECS!) = micro & macro pores
- Humus = adsorption of soluble pollutants (+ charged)

Filtrexx Products 2004
Silt Fence vs Filter Berm

*Journal of Soil & Water Conservation* (Faucette et al., 2005)

Mean Total Solids Load for 3 Storm Events

- **Silt Fence**
- **Filter Berm**

grams/m²

-37%
Silt Fence vs Filter Berm

Journal of Soil & Water Conservation (Faucette et al., 2005)

Nutrient Loads from Hydroseeded Plots during 2nd Storm Event

- Silt Fence
- Filter Berm

mg/m²

Total N
Total P
Performance Testing & Certification Lab for Filtrexx International
Total Solids reduced

Percent

Filter Media 1  Filter Media 2  Filter Media 3  Filter Media 4  Filter Media 5  Filter Media 6  Filter Media 7  Filter Media 8  Filter Media 9  Filter Media 10
Turbidity Reduction w/ Filter Media™

AFTER

BEFORE
Hydrocarbon & Spill Filtration
Motor Oil Removal at 1,000-10,000 mg L

Percent

Filter Media 1
Filter Media 2
Filter Media 3
Filter Media 4
Filter Media 5
Filter Media 6
Filter Media 7
TSS, Tubidity, Motor Oil Reduction for 3 Consecutive Runoff Events

![Bar chart showing percent reduction of TSS, Turbidity, and Motor Oil for 3 runoff events.](chart.png)
WHAT IS THE TAKE HOME MESSAGE FROM THIS STUDY?
Sediment and Nutrient Removal from Storm Runoff with Compost Filter Socks and Silt Fence

A. Sadeghi, B. Faucette, K. Sefton
Compost Socks vs Silt Fence

50% Greater Flow Through Rate for Filter Soxx™
## Sediment Summary

% Reduction of TSS & Turbidity of Silt Fence, Filter Soxx, Filter Soxx + Floc

<table>
<thead>
<tr>
<th>Treatment</th>
<th>TSS</th>
<th>Turbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt Fence</td>
<td>67</td>
<td>52</td>
</tr>
<tr>
<td>Filter Soxx</td>
<td>78</td>
<td>63</td>
</tr>
<tr>
<td>Filter Soxx + Pam 12</td>
<td>91</td>
<td>79</td>
</tr>
<tr>
<td>Filter Soxx + Silt Stop</td>
<td>97</td>
<td>98</td>
</tr>
<tr>
<td>Filter Soxx + BioFloxx</td>
<td>97</td>
<td>94</td>
</tr>
</tbody>
</table>

*Total Solids removal efficiency for Filter Soxx = 90%*
Total Phosphorus

![Graph showing the total phosphorus levels over time for different samples under four conditions: Silt Fence, Filtrexx Filter Media #1, and Filtrexx Filter Media #2. The x-axis represents the sample number (t1 to t29), and the y-axis represents total P (mg L^-1). The graph demonstrates a decrease in total phosphorus levels over time for all conditions.](image-url)
SOLUBLE P

Soluble P Loss Averaged Over 30 min of Runoff

mg L

Bare Soil  Filter Sock
Soluble P

Filter Soxx + P-Loxx = 99% reduction
NPK 25-27-5 Fertilizer Applied at 150 lbs/ac
WHAT IS THE TAKE HOME MESSAGE FROM THIS STUDY?
Flow-Through Rate & Design Capacity of Compost Socks & Silt Fence in Sediment Control Applications

- Design capacity prediction model for Silt Soxx™ vs Silt Fence
- MS Excel™ based program
- Engineers, L.A.’s, E&SC/SWPPP Designers
- Inputs = storm intensity or total rainfall, storm duration, area of watershed, potential runoff reduction, slope length & degree, length of filter, ht/diameter of filter
- Outputs = Y/N failure, time to failure

H. Keener, B. Faucette, M. Klingman
Results:
Design Capacity

- Avg flow rates were 50% greater for filter socks
- Ponding height as much as 75% greater for silt fence

- < 5 gpm/linear ft: 8” Silt Soxx™ = 24” silt fence; 12” Silt Soxx™ > 36” silt fence
- > 5 gpm/linear ft: 12” Silt Soxx™ = 36” silt fence; 18” Silt Soxx™ > 36” silt fence

SO WHAT?
1. Higher flow rate = higher design capacity = greater drainage area;
2. Greater drainage area = less BMP installation/inspection/maintenance;
3. Less cost to contractor and/or inspectors

*Based on 30 min. of flow with sediment concentration at 10,000 mg L⁻¹
WHAT IS THE TAKE HOME MESSAGE FROM THIS STUDY?