# TechLink Research Summary #3327
# Performance & Design of Filtrexx® Slope Protection at Various Depths & Slope Grades vs Common Slope Stabilization Practices

Filtrexx® Slope protection has been widely used for erosion control and slope stabilization applications and published research has quantified their effectiveness (Persyn et al, 2004; Mukhtar et al, 2004; Faucette et al, 2005, Faucette et al, 2006, Faucette et al, 2007). Although standard specifications have been developed and utilized for years, principally based on this body of research, no research has directly quantified: 1) how Filtrexx® Slope protection performs relative to other slope stabilization practices, such as rolled erosion control blankets (RECBs), polyachrylamides (PAMs), and tackifiers; 2) the performance of various Slope protection thicknesses; 3) the effect of slope steepness on compost blanket performance. No research has been published evaluating Filtrexx® Slope protection on slopes greater than 3:1, and nearly all research has used a compost blanket thickness of approximately 2 inches or greater. Published research has already shown that Filtrexx® Slope protection performs better than topsoil (Persyn et al, 2004), hydromulch (Faucette et al, 2005) and straw mulch (Faucette et al, 2007); however, comparison to higher end erosion control products and technologies has not been conducted.

| Erosion Control Practice | Soil loss @ 2 in/hr 20 min (0.67 in) | | | Soil loss @ 4 in/hr 40 min (2.0 in) | | | Soil loss @ 6 in/hr 60 min (4.0 in) | | |
|---|---|---|---|---|---|---|---|---|---|
| | lbs | t/ac | % reduction | lbs | t/ac | % reduction | lbs | t/ac | % reduction |
| Bare soil | 84 | 61 | NA | 563 | 137 | NA | 1507 | 171 | NA |
| CECB™ 2.0 in | 0.18 | 0.02 | 99.8 | 187 | 46 | 66.8 | 424 | 48 | 71.9 |
| CECB™ 1.0 in | 0.73 | 0.09 | 99.1 | 219 | 53 | 61.1 | 468 | 53 | 68.9 |
| CECB™ 0.5 in | 40 | 29 | 52.1 | 394 | 96 | 30.1 | 638 | 72 | 57.7 |
| Single-net straw | 44 | 31 | 48.8 | 348 | 84 | 38.3 | 893 | 101 | 40.8 |
| Single-net excelsior fiber | 24 | 18 | 70.2 | 224 | 55 | 60.1 | 585 | 66 | 61.1 |
| Double-net straw | 31 | 23 | 62.7 | 255 | 62 | 54.7 | 664 | 76 | 56.0 |
| Double-net coconut fiber | 0.44 | 0.05 | 99.5 | 149 | 36 | 73.5 | 621 | 71 | 58.8 |
| Tackifier | 17 | 12 | 79.9 | 246 | 60 | 56.2 | 886 | 101 | 41.2 |
| PAM | 59 | 43 | 29.9 | 603 | 146 | -6.8 | 1390 | 158 | 7.7 |
| CECB™ 2.0 in + LockDown™ Netting | 0.04 | 0.005 | 99.9 | 121 | 29 | 78.6 | 465 | 53 | 69.1 |
| CECB™ 1.0 in + LockDown™ Netting | 0.13 | 0.02 | 99.8 | 182 | 44 | 67.7 | 443 | 50 | 70.6 |
| CECB™ 0.5 in + LockDown™ Netting | 1.6 | 0.2 | 98.1 | 262 | 64 | 53.5 | 834 | 95 | 44.7 |
| CECB™ 0.5 in + PAM | 2.9 | 0.4 | 96.7 | 484 | 118 | 14.1 | 1254 | 142 | 16.8 |
| CECB™ 1.0 in + Single-net excelsior fiber | 0.37 | 0.05 | 99.6 | 7 | 0.9 | 98.7 | 14 | 1.7 | 99.1 |

**Table 1: Cumulative soil loss and soil loss reduction (%) for each erosion control practice relative to bare soil (control), at 2:1 slope, after each 20-minute rainfall intensity increment (total rainfall accumulation).**

| CECB™ Thickness (in) | Slope Angle (H:V) | Soil loss @ 2 in/hr 20 min (0.67 in) | | | Soil loss @ 4 in/hr 40 min (2.0 in) | | | Soil loss @ 6 in/hr 60 min (4.0 in) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | lbs | t/ac | % reduction | lbs | t/ac | % reduction | lbs | t/ac | % reduction |
| Bare soil | 2:1 | 84 | 61 | NA | 563 | 137 | NA | 1507 | 171 | NA |
| 2.0 | 2:1 | 0.18 | 0.02 | 99.8 | 187 | 46 | 66.8 | 424 | 48 | 71.9 |
| 1.0 | 2:1 | 0.73 | 0.9 | 99.1 | 219 | 53 | 61.1 | 468 | 53 | 68.9 |
| 0.5 | 2:1 | 40 | 29 | 52.1 | 394 | 96 | 30.1 | 638 | 72 | 57.7 |
| Bare soil | 3:1 | 75 | 55 | NA | 541 | 132 | NA | 1267 | 144 | NA |
| 2.0 | 3:1 | 0.75 | 0.09 | 99.0 | 108 | 26 | 80.1 | 308 | 35 | 75.7 |
| 1.0 | 3:1 | 2 | 0.25 | 97.4 | 74 | 18 | 86.4 | 629 | 72 | 50.4 |
| 0.5 | 3:1 | 7 | 0.9 | 90.0 | 384 | 94 | 29.1 | 881 | 100 | 30.5 |
| Bare soil | 4:1 | 101 | 72 | NA | 447 | 108 | NA | 972 | 110 | NA |
| 2.0 | 4:1 | 0.04 | 0.005 | 100.0 | 38 | 9 | 91.4 | 169 | 19 | 82.6 |
| 1.0 | 4:1 | 3 | 0.37 | 96.8 | 172 | 42 | 61.4 | 527 | 60 | 45.9 |
| 0.5 | 4:1 | 2 | 0.25 | 98.2 | 230 | 56 | 48.4 | 603 | 68 | 38.0 |

**Table 2: Cumulative soil loss and soil loss reduction (%) for each Slope protection thickness relative to bare soil (control), by slope angle, after each 20-minute rainfall intensity increment (total rainfall accumulation).**

Using ASTM D-6459, Standard Test Method for Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall Induced Erosion, on slope angles ranging from 4:1 to 2:1, 20 different erosion control best management practices (BMP) were compared for their performance and design parameters at San Diego State University's Soil Erosion Research Laboratory (SDSU SERL). Using a

Norton Ladder Rainfall Simulator designed and supplied by the US Department of Agriculture National Soil Erosion Research Laboratory (USDA-ARS NSERL), ASTM specified design storm intensities and durations were applied to each of the erosion control products. The ASTM D-6459 design storm is as follows: 2 in/hr for 20 min, followed by 4 in/hr for 20, followed by 6 in/hr for 20 min, for a total of 60 minutes duration. Each erosion control product was tested in triplicate to obtain statistical averages.

DESIGN CRITERIA

Development of USLE (and RUSLE and RUSLE2) cover management factors (C factors) for erosion control BMPs can assist site planners and designers in predicting and estimating soil loss, which can affect the size and design of other site BMPs such as sediment barriers, traps, ponds or basins; and can assist designers in choosing the optimum performing BMP for their site plan. Cover management factors for all BMP treatments tested are listed in Table 3. The cover management factor for the control (bare soil) is 1.0. The USLE is represented as:

A = r x k x ls x c x p

Where:

A = soil loss rate (tons/ac/yr)

r = rainfall erosivity factor

k = soil erodibility factor

ls = slope length and steepness factor

c = cover management (erosion control) practice factor

p = support practice factor

| Erosion Control Practice | Thickness (in) | Slope Angle (H:V) | USLE C Factor |
|---|---|---|---|
| CECB™ | 2.0 | 2:1 | 0.28 |
| CECB™ | 1.0 | 2:1 | 0.31 |
| CECB™ | 0.5 | 2:1 | 0.42 |
| Single-net straw | NA | 2:1 | 0.59 |
| Single-net excelsior fiber | NA | 2:1 | 0.39 |
| Double-net straw | NA | 2:1 | 0.44 |
| Double-net coconut fiber | NA | 2:1 | 0.41 |
| Tackifier | NA | 2:1 | 0.59 |
| PAM | NA | 2:1 | 0.92 |
| CECB™ + LockDown™ Netting | 2.0 | 2:1 | 0.31 |
| CECB™ + LockDown™ Netting | 1.0 | 2:1 | 0.29 |
| CECB™ + LockDown™ Netting | 0.5 | 2:1 | 0.55 |
| CECB™ + PAM | 0.5 | 2:1 | 0.83 |
| CECB™ + Single-net excelsior fiber | 1.0 | 2:1 | 0.01 |
| CECB™ | 2.0 | 3:1 | 0.24 |
| CECB™ | 1.0 | 3:1 | 0.50 |
| CECB™ | 0.5 | 3:1 | 0.70 |
| CECB™ | 2.0 | 4:1 | 0.17 |
| CECB™ | 1.0 | 4:1 | 0.54 |
| CECB™ | 0.5 | 4:1 | 0.62 |

**Table 3: Cover management factors for erosion control BMPs using ASTM D-6459 after 60 minutes cumulative rainfall.**

| | Rainfall = 0.67 in | Rainfall = 2 in | Rainfall = 4 in |
|---|---|---|---|
| Slope ≤ 4:1 | 0.5 to 2.0 | 2.0 | 2.0 |
| > 4:1 to 3:1 | 1.0 to 2.0 | 1.0 to 2.0 | 2.0 |
| > 3:1 to 2:1 | 1.0 to 2.0 | 1.0 to 2.0 | 1.0 to 2.0 |

**Table 4: Recommended Slope protection thickness (in) based on slope angle (H:V) and rainfall accumulation in a 24 hr period.**

## References


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