TechLink Research Summary #3314

Sediment Storage Capacity of Filtrexx® Sediment Control vs Silt Fence

Sediment storage capacity is the maximum volume of sediment that a sediment control device (SCD) can accumulate either behind the device (upslope) and/or within the filter itself. While silt fence only has the ability to accumulate and store sediment behind the filter fabric, tubular devices, such as compost FilterSoxxtm have the ability to accumulate and store sediment behind the filter and within the matrix of the filter.

Assuming that environmental conditions (soil type, slope degree and length, rainfall-runoff characteristics, erosion control practice) are equal or held constant, there are four variables that can affect the sediment storage capacity of a SCD: 1) the height of the device, 2) the void space or air space within the device, 3) filtering or sediment removal efficiency of the device, and, 4) the maintenance specification for allowable sediment accumulation upslope of the device.

Design and Effective Height

Design height of silt fence and Sediment control is different from the effective height that actually controls runoff and sediment once installed and subject to field conditions. While silt fence is available in 18, 24, 30, and 36 in design heights, the amount of fabric trenched into the ground is generally 8 in (GA SWCC, G DOT, KY EP&SC, VA DCR) to 12 in (Iowa SUDAS, Iowa DNR, MN DOT, NC DENR, SC DOT, OH DOT, PA DEP), and once a constant head of water pressure (from surface runoff) is applied horizontally from the ground to the top of the silt fence it sags between an average of 3 in (24 in silt fence) and 6 in (36 in silt fence) (Keener et al, 2006). Wire or fence reinforced silt fence only sags about 3 in (for 36 in silt fence). Therefore the effective height of a 24 in silt fence is 13 in; the effective height of a 36 in silt fence is 18 to 22 in; and the effective height of wire reinforced silt fence is 21 to 25 in.

Table 1: Total sediment storage capacity (sediment storage within + sediment storage behind) at 0% slope, per linear ft of silt fence and Sediment control

SCD	Design Height (in)	Effective Height (in)	Maximum Sediment Storage Height (in)	Sediment Storage Length (upslope) (in)	Sediment Storage within + behind SCD (in3)	Total Sediment Storage Capacity (in3)
Silt Fence	24	13	6.5	6.5	0 + 254	254
Silt Fence	36	20	10	10	0 + 600	600
Silt Fence	36 reinforced	23	11.5	11.5	0 + 794	794
SiltSoxx	8	6.5	3.25	3.25	111 + 63	174
SiltSoxx	12	9.5	4.75	4.75	261 + 135	369
SiltSoxx	18	14.5	7.25	7.25	542 + 315	857
SiltSoxx	24	19	9.5	9.5	1089 + 542	1631

Sediment control is available in 8, 12, 18, 24, and 32 in design diameters. Once installed and a constant head of water pressure is applied (from surface runoff) they sag (or bow) between 1.5 in (8 in), 2.5 in (12 in), 3.5 in (18 in) and 5 in (24 in). Sediment control is generally not trenched into the soil. Therefore the effective height of a 12 in sock is 10 in and an 18 in sock is 15 in. When determining sediment storage capacity of a SCD the effective height should be used, not the design height.

Void Space within SCDs

An average 8 in Sediment control contains 1/60 or 0.017 cubic yards (793 cubic inches) of compost filter media per linear ft., a 12 in Sediment control contains 1/25 or 0.04 cubic yards (1866 cubic inches) of compost FilterMediatm per linear ft, an 18 in Sediment control contains 1/12 or 0.083 cubic yards (3872 cubic inches) of compost FilterMediatm per linear ft, and a 24 in Sediment control contains 1/6 or 0.167 cubic yards (7792 cubic inches) of compost FilterMediatm per linear ft. Based on laboratory testing of field filled Filtrexx Certified FilterMediaTM, analyzed at the Soil Control Lab in Watsonville, CA., the average volumetric void space, or air space, of compost FilterMediaTM once inserted and installed with a FilterSoxxtm is 20%. This air space is created due to the heterogeneous mixture and placement of specified material particle sizes (and shape variation) of the compost FilterMediaTM that are inserted into the FilterSoxxTM. The void space created within the Sediment control is air space that can accumulate and store

sediment as it moves into the filter (compost FilterMediaTM occupies the area within the Sediment control that is not free air space). A silt fence has no quantifiable void space in which to accumulate and store sediment, therefore, sediment storage for silt fence is exclusively behind (upslope) the filter fabric.

Filtering Efficiency and Maintenance for Sediment Accumulation

Based on research conducted by the USDA ARS (Sadeghi et al, 2006) and The Ohio State University (Keener et al, 2006) sediment removal efficiencies for silt fence and Sediment control are similar, therefore the rate at which they accumulate sediment is assumed to be equal for this exercise.

Maintenance requirements for sediment accumulation behind SCDs according to state erosion and sediment control manuals (GA SWCC, 2000; KY EP&SC, 2005; SC DOT, 2005; WS DOT, 2005) and manufacturers' specifications usually call for removal (of the sediment) once accumulation has reached 1/3 to ½ the height of the SCD.

Sediment Storage Capacity

To determine sediment storage capacity we will make the following assumptions: filtering efficiency of sediment for silt fence and Sediment control are equal; the maximum allowable height of sediment accumulation behind the SCD is ½ of the effective height; and the horizontal length (in) of accumulated sediment behind (i.e. upslope) the SCD will be equivalent to the sediment accumulation height (in); the slope of the land area above the SCD is 0% (or no more than 10%). State and manufacturer specifications for SCDs often recommend the device be installed at least 5 ft from the toe of the slope to allow for maximum sediment storage behind the device. Total sediment storage capacity (volumetric) is determined by the following formula:

$Sc = (Hs \times Ls \times 12)(0.5) + I$

Where:
Sc = total sediment storage capacity per linear ft of SCD (cubic inches)
Hs = maximum allowable sediment storage height (in)
Ls = horizontal length of sediment accumulated upslope of SCD (in)
12 = in per linear ft
I = maximum sediment storage within the SCD per linear ft (cubic inches)

And:
$I = (v/l)(0.2)(0.7)(46{,}656)$

Where:
v = volume of compost (cubic yards)
l = length of sock per cubic yard of compost (linear ft)
0.2 = void space within a linear ft of compost FilterSoxxtm (%)
0.7 = safety factor, whereas sediment may fill up to 70% of the air space within a tubular SCD
46,656 = conversion to cubic inches from 1 cubic yard

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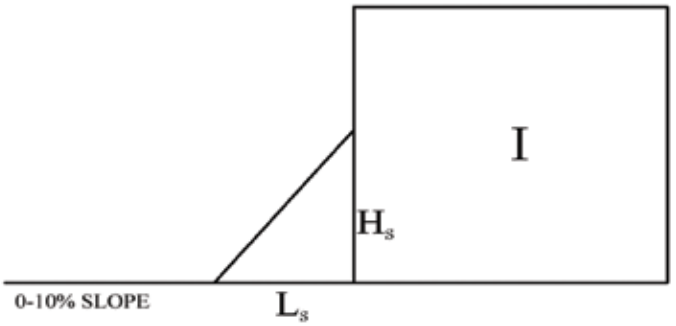

Figure 1: Diagram of sediment control device and variables used to calculate sediment storage capacity

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