filtrexx®
SUSTAINABLE TECHNOLOGIES

TechLink Research Summary #3313

Design for Sediment Control Structures: Filtrexx® SiltSoxx™ & Silt Fence

An MS Excel™ based interactive design capacity prediction model was created by engineers at The Ohio State University so designers working with runoff/sediment control devices can easily determine the following design considerations based on real site and rainfall conditions: slope spacing between sediment/runoff control devices, maximum allowable slope length or watershed area draining to a sediment/runoff control device, time until sediment/runoff control device will overflow, runoff rate required to overflow sediment/runoff control device, and effective height of the sediment/runoff control device after field installation and under field conditions. The design tool allows the user to choose the appropriate design height/diameter control device and to compare the performance of each effective height/diameter for silt fence and Filtrexx® Sediment control. Site and rainfall input parameters that the user can manipulate include: total rainfall (in)/duration (hrs), rainfall intensity (in/hr)/duration (hr), area of watershed (ac) or slope width (ft) and length (ft), percent slope, potential runoff reduction (%) for soil/vegetation/erosion control/management practices, effective length of filter used to drain watershed area, diameter of Filtrexx® Sediment control, and height of silt fence. The output tells the user whether the silt fence and/or Filtrexx® Sediment control will fail based on the input parameters and how long (hrs) it will take for each control device to overflow.

Step 1: Choose units, ft or m		ft					
Step 2. Choose input: Tr or I		Tr					
total rainfall	inches	1.5		storm duration	hours	24	
Step 3. Choose input: A or W		W					
width of area	ft	400.00		length of slope	ft	250	43560
Step 4. Input slope	%	10					452.588
Step 5. Input reduction runoff percent	%	10					
		siltsoxx (8,12,18)	silt fence(24,30)				
Step 6. Input effective length of filter	ft	400	400				
Step 7. Input diameter/height of filter	inches	12	36				
Step 8. Find time to overflow filter and total flow/ft the filter can handle							
Step 9. On figure find for given flow expected time to overflow filter.							

Part A. Evaluation of q_i

I inches/hr	A acres	s percent	Q gpm	L_{ss} ft	q_i gpm/ft
0.063	2.2957	10	58.15	400	0.145

Part B. Predicted time and total flow to top filter.

	q_o gpm/ft	D inches	Effective D inches	time overflow hr	total flow gal/f	Filter Okay time > tr
SiltSoxx™ (Coarse Material)	0.145	12	9.6	99.1	865	OKAY
Silt Fence	0.145	36	30.6	97.5	851	OKAY

The design tool is based on research results, the ponding formula and calculations described below for silt fence and Filtrexx® Sediment control, and the equation for site and rainfall/runoff characteristics described below in Figure 1. A copy of the research and/or design tool completed by The Ohio State University can be obtained from Filtrexx International.

Table 1: Time to overflow at three flow rates* for silt fence and Filtrexx® SiltSoxx™

Sediment Control Device	Flow Rate 1 gpm/linear ft	5 gpm/linear ft	7.5 gpm/linear ft
36 in silt fence	6.5 hrs	2 hrs	45 min
30 in silt fence	5 hrs	1.5 hrs	30 min
24 in silt fence	3.5 hrs	1 hr	20 min
18 in Filtrexx® SiltSoxx™	11.5 hrs	4 hrs	1 hr
12 in Filtrexx® SiltSoxx™	7.5 hrs	2.5 hrs	30 min
8 in Filtrexx® SiltSoxx™	5 hrs	1.5 hrs	10 min

** Sheet flow runoff with 10,000 mg L-1 of suspended solids consisting only of silt and clay.*

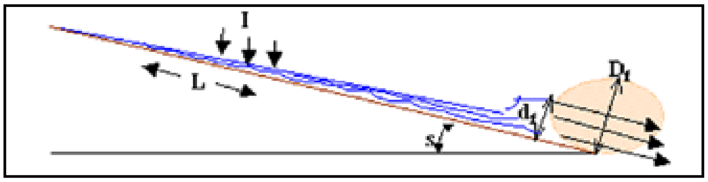

Figure 1. Diagram representation of control structure in operation and listing of variables used to calculate water runoff rates from a slope.

Formulas:

Formula to determine ponding depth behind sediment/runoff control device:

df = A(qf)t + B(qf)

Where:

df = pond depth (in)
qf = sediment-laden flow rate (gal/linear ft/min)
t = time (min)
A(qf) = rate of increase in depth as a function of runoff flow rate (sediment-laden) and suspended solids concentration of runoff (in/min)
B(qf) = initial pond depth behind filter before sediment clogging occurs (in)

Based on results from the research at Ohio State University and this formula the following calculations were developed to estimate time to overflow a silt fence and a Silt Soxx.

Silt Fence: t = df - (1.1932qf + 1.2993)/0.0132 qf + 0.029
Filtrexx® Sediment control: t = df - (0.8282exp0.2564qf)/0.014exp 0.3132qf

The equations for runoff are:

Q =[I W L cos(s) 7.48 /(60 *12)] = 0.01039 I W L cos(s)
Q = 0.01039 I W L cos(s)
qf = Q/W

Where:

Qf = flow rate to filter, gpm
I = rainfall intensity, in/hr
W = width, i.e. length of filter, feet
L = length of slope, feet
s = angle of slope, degrees
df = depth of water at the filter measured to slope, inches
qf = flow rate to filter, gpm/f

Runoff Reduction Coefficient:

The runoff reduction coefficient was incorporated into the equation for predicting runoff using the following relationship:

qf = (100 - RC)/100 * Q/W

where:

qf = flow rate to Filtrexx® Sediment control (gpm/ft)
Q = flow rate to Filtrexx® Sediment control (gpm)
W = width, i.e. length of sediment control filter (ft)
RC = runoff reduction coefficient (percent)

RC accounts for loss of water volume (mass) due to the effects of absorption by ground cover and/or infiltration as it moves down the watershed to the sediment control structure. Past research has shown values ranging from 0 for concrete to as much as 60% for some compost blankets and mulches.

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