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Sediment and Nutrient Removal from Storm Runoff with Compost Filter Socks and Silt Fence

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Abstract. *Compost Filter Socks, used in a variety of sediment control and storm water management applications, are being used primarily to filter sediment and other potential pollutants in storm water runoff. The objective of this study was to evaluate flow through rates and sediment and nutrient removal or loss capability of these newly developed sediment control devices. Five experimental treatments were replicated in triplicate: three filter sock treatments, silt fence (24 in.) and control (no sediment control). The treatments were installed in large chambers (110 cm x 35 cm x 25 cm), to roughly simulate the field conditions, with 2 to 3 inches of silt loam soil. Chambers were adjusted on the rain simulated table to have a 10% slope. A rainfall simulation system was used to provide 3 inches/hour of rainfall intensity for 0.5 hr duration on the respective chamber treatments. Runoff samples were taken at the base of the soil chamber immediately after overland flow runoff passing through the treatment. Samples were quantified for turbidity, total solids, total N, ammonium N, nitrate + nitrite N, and total P and dissolved reactive P concentrations. Direct water balance measurements included total rainfall and total runoff. Flow rates from the filter socks averaged 50%*

greater than that of silt fence while total sediment concentrations in runoff were not diminished. Compost filter socks reduced total phosphorus in runoff relative to the bare soil, while one compost filter sock treatment reduced soluble reactive P by 50%.

Keywords. Filter socks, Silt Fence, Erosion, Storm Runoff, Sediment Removal, Sediment Control.

Introduction

Due to Phase II enforcement of the National Pollution Discharge Elimination System for storm water discharge from construction activities in 2003, evaluating the effectiveness and performance level of sediment control devices has never been more important. Because noncompliance fines and stop work orders are issued based on sediment leaving a construction sites or entering receiving waters, increased emphasis has been placed on sediment control devices over erosion control practices, to function properly. As states' begin to revise their erosion and sediment control manuals to reflect new information on best management practices (BMPs), many are requiring that erosion and sediment control practices meet a minimum performance standard (SC DOT, 2006). Slope protection practices (single net straw blanket, compost erosion control blanket) normally use Cover (C) Factors (from the RUSLE) to compare and evaluate the effectiveness between these practices and products. Channel protection practices (turf reinforcement mat, rip rap, compost channel socks) normally use maximum shear stress values to compare and evaluate the effectiveness between these practices and products. Although there is no standard test method to compare and evaluate between sediment control devices (silt fence, straw bale, straw wattle, compost filter socks), there is an ASTM test method (D 5141) for testing sediment removal efficiency for silt fence.

Silt fence is the current industry standard used for sediment control in construction activities; therefore, its performance has been widely evaluated (Wyant, 1981; Fisher and Jarret, 1984; USEPA, 1993; Barrett et al, 1998; Britton et al, 2000). In a study evaluating the sediment trapping efficiency of silt fence, Wishowski et al, observed that as sediment particle sizes decrease, trapping efficiency declines (1998). Barrett et al (1998) adds that most studies reporting sediment removal efficiencies for silt fence are somewhat overstated since many have used a disproportionately large fraction of sand particles with relatively low sediment-laden concentrations of stormwater runoff. They observed 92% of the total suspended solids were clay and silt, were an order of magnitude smaller than the openings in the silt fence fabric, and due to very low settling velocities are normally not removed by sedimentation (Barrett et al, 1998). Barrett et al (1995) reported that silt fence sediment trapping efficiency is a result of increased ponding behind the silt fence. A similar study by Kouwen (1990) concluded that excessive ponding of runoff is due to eroded sediment clogging the silt fence filter fabric. Barret et al (1998) later discovered that sediment removal efficiency by silt fence was attributable to duration of runoff detention behind the silt fence, not the filtration of the fabric.

In 2005, the US EPA National Menu of BMPs for Storm Water Phase II listed compost filter socks as an approved BMP for controlling storm runoff on construction sites (US EPA, 2006). In addition, nearly 30 state and local agencies have approved the use of compost filter socks for control of sediment originating from construction activities (Filtrexx International, 2006). Due to its increased surface area and wider, three dimensional construction, filter socks are specifically designed to trap sediment and reduce turbidity in stormwater runoff without excessive ponding, characteristic to silt fence. In a study conducted at the University of Georgia using three simulated storm events, on a 10% slope, filter berms (uncontained filter socks) reduced total solids loads by 35% and exhibited 21% greater runoff flow rates relative to silt fence on sandy clay loam subsoil (Faucette et al, 2005).

Under bench scale conditions on a 3:1 slope, using simulated runoff with a total sediment concentration of 3000 mg L-1, Faucette and Tyler (2006) reported an average sediment removal efficiency of 98% for 10 filter socks tested. Suspended solids concentration and turbidity (NTUs) reduction averaged 70 and 55%, respectively, over three runoff events. Although test methods vary considerably, below are some reported results on sediment trapping efficiency for silt fence, compost filter socks, and compost filter berms (Table 1).

While compost filter socks have been used primarily for controlling sediment, there is evidence in the literature that compost can have the ability to filter soluble nutrients, through chemical adsorption. The humus fraction of compost has the ability to chemically adsorb free cations, such as soluble phosphorus (P) and ammonium nitrogen (N) (Brady and Weil, 1996). Faucette and Tyler (2006) also reported motor oil removal efficiencies between 85 and 99% with initial runoff concentrations of motor oil ranging between 1,000 and 10,000 mg L-1. Additionally, minor removal rates between 1 and 7 mg L-1 for nitrate-N and total P were also reported.

Materials may be added to compost filter socks to target specific pollutants in storm water that are characteristic to land disturbing activities. Example materials include anionic flocculants used to further reduce suspended solids, turbidity, and soluble P in storm runoff. Construction sites that have predominantly clay or silty soils are prone to highly turbid runoff conditions, while BMPs that reduce soil erosion and sediment concentration often do little to reduce soluble P concentrations (Leytem and Bjorneberg, 2005). Hayes et al (2005) found that polymers can reduce average turbidity on disturbed soils characteristic to construction sites. Leytem and Bjorneberg (2005) reported a 98% reduction in soluble P concentrations in sediment ponds using flocculants. By adding these materials to compost filter socks, target pollutants can be treated in sheet runoff and concentrated flow situations prior to reaching receiving waters. These new applications may be of critical importance on highly disturbed silt and clay soils, soils recently fertilized for vegetation establishment, or near total maximum daily load (TMDL) listed receiving waters.

The objectives of this study were, i) to determine and compare the sediment removal efficiency of silt fence and compost filter socks under the same test conditions, ii) to determine if the addition of polymers to compost filter socks could reduce turbidity, suspended solids, and soluble P in runoff relative to silt fence.

Table 1: Sediment Removal Efficiencies for Various Sediment Control Devices.

Sediment Control Device	Sediment Removal Efficiency	Reference
Silt Fence	3% turbidity	Horner, 1990
Silt Fence	0% turbidity	Barrett et al, 1998
Silt Fence	0-20% clay	US EPA, 1993
Silt Fence	50% silt	US EPA, 1993
Silt Fence	80+ % sand	US EPA, 1993
Silt Soxx	98% total solids	Faucette & Tyler, 2006
Silt Soxx	70% suspended solids	Faucette & Tyler, 2006
Silt Soxx	55% turbidity	Faucette & Tyler, 2006
Filter Berm vs Silt Fence	35% less total solids	Faucette et al, 2005
Filter Berm vs Silt Fence	91% less total solids	Demars & Long, 2000
Filter Berm vs Straw Bale	92% less total solids	Demars & Long, 2000
Filter Berm vs Silt Fence	72% less total solids	Ettlin & Stewart, 1993
Filter Berm vs Silt Fence	91% less suspended solids	Ettlin & Stewart, 1993

Materials and Methods

Rainfall Simulation System

The laboratory study was set up to simulate rainfall and to collect and examine runoff from soil chambers with sediment control devices installed. The rainfall-runoff simulation system used in this study has been previously described in detail by Isensee and Sadeghi (1999). In brief, the rainfall-runoff simulation system consists of an adjustable rainfall simulator (two oscillating linear dripping units that provide simulated rain at 0° and 180° over the raintable), a peristaltic pump to supply water to the dripper units, a 2.4 m diameter, 1-rpm turntable (that supports and rotates the soil chambers under oscillating dripping units), four chamber elevation platforms (to support the soil chambers at the desired slope of 0-20%), and fifteen soil chambers. The soil chambers used in this experiment are constructed of 15 mm thick plywood, with inside dimensions of 100 cm length by 35 cm width by 25 cm depth, and are described in detail in Sadeghi and Isensee (2001).

Tipping buckets gauges and recording data logger (as described in Isensee and Sadeghi, 1999) were used only in the first experiment to measure and collect runoff. It was decided after experiment I, that the tipping bucket gauges were too cumbersome during the fast-paced sample collection events. This data (runoff L min-1) was manually collected during experiments II, III and IV in order to later develop the hydrographs.

Soil Chambers and Treatment Installation

The soil chambers were prepared by packing a Hatboro silt loam soil into each of the 16 chambers (15 treatments plus 1 extra chamber). The soil was added in small increments to the chambers, and packed with a pressure of approximately 0.15 kg cm-2 before the next addition (as described in Sadeghi and Isensee, 2001). Soil was packed until the chambers contained 7.62 cm of soil (three inches). 24 to 48 hours before the runoff simulation, the chamber drains were plugged, and chambers were placed on the raintable and rained on for fifteen minutes at a rate of 5.4 cm h-1, to pre-wet the soil. The adjustable runoff drain was then unplugged and the gate was positioned so the runoff drain was level with the soil surface. Silicone was used to seal the gate in place, and prevent any leaks during the simulation. The Sediment Control Treatments were then installed on the down-slope side of the chamber, near the runoff drain. The experimental treatments installed in each chamber are outlined in Table 2. The 20.3 cm (8 in) diameter filter socks were installed by compacting 5 kg of compost into each sock, and securing the ends. Flocculents and phosphorous-reducing agents were added to the socks, in experiments III and IV, respectively. The treatment properties and additives are outlined in Table 3, and explained in detail in the next section. The 91.4 cm (36 in) high silt fence was installed in a V-formation (so ends were positioned upslope), at the down-slope end of the chamber. Six inches of the silt fence were trenched into the soil, 6.4 cm (2.5 in) deep and 8.9 cm (3.5 in) upslope. The soil displaced by trenching was replaced and thoroughly compacted around the silt fence prior to rainfall-runoff simulation. The top 30.5 cm (12 in) of the silt fence was cut off after installation (sediment accumulation and flow rates did not require the extra material).

Table 2. Experimental Treatments

		Exp. I	Exp. II	Exp. III	Exp. IV
	Chamber	Erosion Control Treatment			
Run #1	A	Silt Fence	Silt Fence	Silt Fence	Silt Fence
	B	Sock – Iowa	Sock – Alberta	Sock w/ BioFloxx	Sock w/Powder Alum + Gypsum
	C	Sock – Filtrexx	Sock – Filtrexx	Sock w/PAM	Sock w/Powder Alum
	D	Sock - Denver	Sock – British Columbia	Sock w/SS	Sock w/ Granular Alum
Run #2	E	Sock – Iowa	Sock – Alberta	Sock w/ BioFloxx	Sock w/Powder Alum + Gypsum
	F	Sock – Filtrexx	Sock – Filtrexx	Sock w/PAM	Sock w/Powder Alum
	G	Sock - Denver	Sock – British Columbia	Sock w/SS	Sock w/Granular Alum
	H	Bare Soil*	Bare Soil	Bare Soil	Bare Soil
Run #3	I	Sock – Filtrexx	Sock – Filtrexx	Sock w/PAM	Sock w/Powder Alum
	J	Sock - Denver	Sock – British Columbia	Sock w/SS	Sock w/Granular Alum
	K	Bare Soil	Bare Soil	Bare Soil	Bare Soil
	L	Silt Fence	Silt Fence	Silt Fence	Silt Fence
Run #4	M	Bare Soil	Bare Soil	Bare Soil	Bare Soil
	N	Silt Fence**	Silt Fence	Silt Fence	Silt Fence
	O	Sock - Iowa	Sock - Alberta	Sock w/ BioFloxx	Sock w/Powder Alum + Gypsum
	P	Bare Soil			

* Exp. I - samples were lost after collection – repeated replicate in 4th run with chamber P
** Exp. I - chamber leaked during experiment, lost significant volume

Table 3. Treatment Properties for Experiment I through IV.

				Particle Size Distribution of Experimental Treatments (%)								
Exp #	**Treatment**	**Chambers**	**Compost source**	**>25mm/ >1.0in**	**16-25mm/ 0.63-1.0in**	**9.5-16.0mm/ 0.37-0.63in**	**6.3-9.5mm/ 0.25-0.37in**	**4-6.3mm/ 0.16-0.25in**	**2-4mm/ 0.079-0.16in**	**<2mm/ <0.079in**	**Sock additive**	**Soil Surface additive**
I	Bare Soil	H, K, M, P	-	-	-	-	-	-	-	-	-	-
	Silt Fence	A, L, N	-	-	-	-	-	-	-	-	-	-
	Iowa Sock	B, E, O	Iowa	2.7	12.3	13.7	14.9	11.2	11.2	34	-	-
	Filtrexx Sock	C, F, I	Filtrexx	0	16.1	39.6	13	6.3	7.2	17.8	-	-
	Denver Sock	D, G, J	Denver	12.4	14.1	28.2	21.8	9.8	4.7	9	-	-
II	Bare Soil	H, K, M	-	-	-	-	-	-	-	-	-	-
	Silt Fence	A, L, N	-	-	-	-	-	-	-	-	-	-
	Alberta Sock	B, E, O	Alberta, Ca	0	0	22.1	28.2	22.3	12.4	15	-	-
	Filtrexx Sock	C, F, I	Filtrexx	0	16.1	39.6	13	6.3	7.2	17.8	-	-
	British Columbia Sock	D, G, J	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	-	-
III	Bare Soil	H, K, M	-	-	-	-	-	-	-	-	-	-
	Silt Fence	A, L, N	-	-	-	-	-	-	-	-	-	-
	Sock w/BioFloxx	B, E, O	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	100 g BioFloxx	-
	Sock w/PAM	C, F, I	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	100 g PAM	-
	Sock w/SS	D, G, J	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	100 g SS	-
IV	Bare Soil	H, K, M	-	-	-	-	-	-	-	-	-	5.88 g of 10:27:5 fertilizer applied to soil surface of each chamber (150 lb/acre as ortho-P)
	Silt Fence	A, L, N	-	-	-	-	-	-	-	-	-	
	Sock w/Powder Alum + Gypsum	B, E, O	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	75 g Phosfloc + 75 g Gypsum	
	Sock w/Powder Alum	C, F, I	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	150 g Phosfloc	
	Sock w/ Granular Alum	D, G, J	British Columbia	0	14.9	44.8	13.4	7	6.9	13.1	150 g On Guard	

Compost Properties and Sock Preparation

Compost filter media used within the filter sock was supplied by erosion control contractors currently using the compost sock technology for sediment control on construction activities. No processing of compost filter media was conducted once received at the experimental laboratory from the erosion control contractors. Pre-weighed flocculent and phosphorus reducing agents were added and thoroughly mixed with compost filter media by stirring the materials together in a 18.9 L (5 gal) bucket followed by vigorously shaking and rolling the sealed bucket for approximately 2 min. See table 3 for flocculent and phosphorus reducing agent weights and their corresponding filter sock treatments. After mixing, the filter media and additives were then filled and compacted into the filter sock. After filter socks were filled and placed on the soil chambers, compost filter media was used to backfill chamber corners and the sock and soil contact interface, as is typically done during field installation.

The compost filter sock material is made of 5 mm thick HDPE photodegradable plastic with 9.5 mm (3/8 in) diamond mesh openings. The mesh allows water to flow freely through the filter sock, while containing the filter media and any potential sediment solids present in runoff.

Particle size distribution of each compost filter media was determined. Particle size distribution of the filter media may affect pollutant removal efficiency and flow through rate of the filter sock (Faucette et al, 2006 – ICRW Proceedings). A sub sample of the compost filter material taken prior to runoff analysis was analyzed for particle size distribution (TMECC 02.02 B) using test methods described by the Test Methods for the Examination of Composting and Compost (US Composting Council, 1997). See Table 3 for particle size distributions for each filter media experimental treatment.

Experimental Setup

Four Chambers can be supported on the turntable at a time, so each of the four experiments (I, II, III and IV) consisted of four runs (1, 2, 3 and 4), to simulate rainfall and generate runoff from the 15 chambers. See Table 2 for the experimental treatments and runs.

Before each run, the chambers were elevated to 10% slope and three to four cans were put in place on the raintable, in order to quantify the rainfall rate. A timer was started and the raintable (drippers and rotational motor) were turned on. Pre-labeled 500 ml glass jars were put in position to collect all runoff generated from the chambers. A crew of three collected the runoff samples approximately every 50 seconds, from each chamber, while a fourth person monitored the timer, and collected data on the time of first runoff flush and time of each sample collection. The chambers were exposed to rainfall for 30 minutes, and all runoff generated was collected, measured, and processed. See Table 4 for simulated rainfall intensity and duration of each run.

Table 4. Simulated Rainfall Intensity and Duration

		Exp. I		Exp. II		Exp. III		Exp. IV	
	Chambers	Intensity cm/hr	Duration min	Intensity cm/hr	Duration min	Intensity cm/hr	Duration min	Intensity cm/hr	Duration min
Run #1	A, B, C, D	5.41†	30	8.21	30	9.19	30	8.40	30
Run #2	E, F, G, H	4.84†	30	7.61	30	8.90	30	8.95	30
Run #3	I, J, K, L	4.26†	30	7.81	30	8.85	30	8.50	30
Run #4	M, N, O, P*	4.93†	30	5.93†	30	8.70	30	8.68	30

* Chamber P only in Exp. I

† peristaltic pump tubing leak, discovered after run

Physical and Chemical Measurements

All runoff generated were collected in 500 ml pre-weighed glass jars. After the experiment, all jars were weighed to calculate the total volume of runoff. This data was combined with the time collected data to develop the hydrographs for each chamber.

Due to the high number of samples collected (25-36 per chamber, collected every 45-55 seconds), every third or fourth sample was processed for soluble P, total P, TSS, TS and turbidity. Using a 20 ml syringe (BD Luer-Lok, #305617), an aliquot of sample was passed through a 0.45 µm syringe filter (Pall IC Acrodisc, #AP-4585). This filtered sample was processed using flow injection analysis for orthophosphate (Lachat QuikChem method # 10-115-01-1-A). Another 50 ml aliquot of raw sample was digested by persulfate digestion method (G.M.Pierzynski, 2000) to oxidize the organic and particulate matter and release all phosphorous as orthophosphate. This digested sample was also processed using flow injection analysis for orthophosphate (Lachat QuikChem method # 10-115-01-1-A), to quantify the total P concentration.

The Turbidity of each sample was quantified using the LaMotte 2020 Turbidimeter. The Total Solids (TS) were quantified by measuring out 100 ml of raw sample into a pre-weighed tin, and placing the tin in a drying oven at 104°C for 24 hours. The residue was then weighed to determine g/L TS. The Total Suspended Soilds (TSS) were quantified by filtering 100 ml of raw sample through a glass microfiber filter (Whatman #934-AH), using a buchner funnel and light vaccum. The pre-weighed filters were then dried in a drying oven at 104°C for one hour, and then weighed to determine g/L TSS.

Analysis of Results

Total mass loads were determined for TS, TSS, total P and soluble P. Mass loads were calculated by summing the total of each sample concentration multiplied by the sample volume. Flow rates were converted from ml/sec to L/min/linear cm and gal/min/linear ft by correcting for box width (35 cm) to a standard linear length of sediment control device (cm or ft). Support practice (p) factor was defined as the soil loss ratio from the sediment control device treatments relative to a bare soil (control) with no support practice, which is equal to 1.0.

Results

Flow rates from the filter socks averaged 50% greater than that of silt fence while total sediment concentrations in runoff were not diminished (See table 5).

Compost Filter Socks reduced total phosphorous in runoff relative to the bare soil, while one compost filter sock treatment reduced soluble reactive P by 50%. See Figures 1 and 4 and Tables 5 and 6.

All three flocculent agents added to the filter socks in Experiment III significantly reduced the sediment loss, however one flocculent (SS) formed a thick film on the soil surface and significantly reduced the flow-through rate (46.89%).

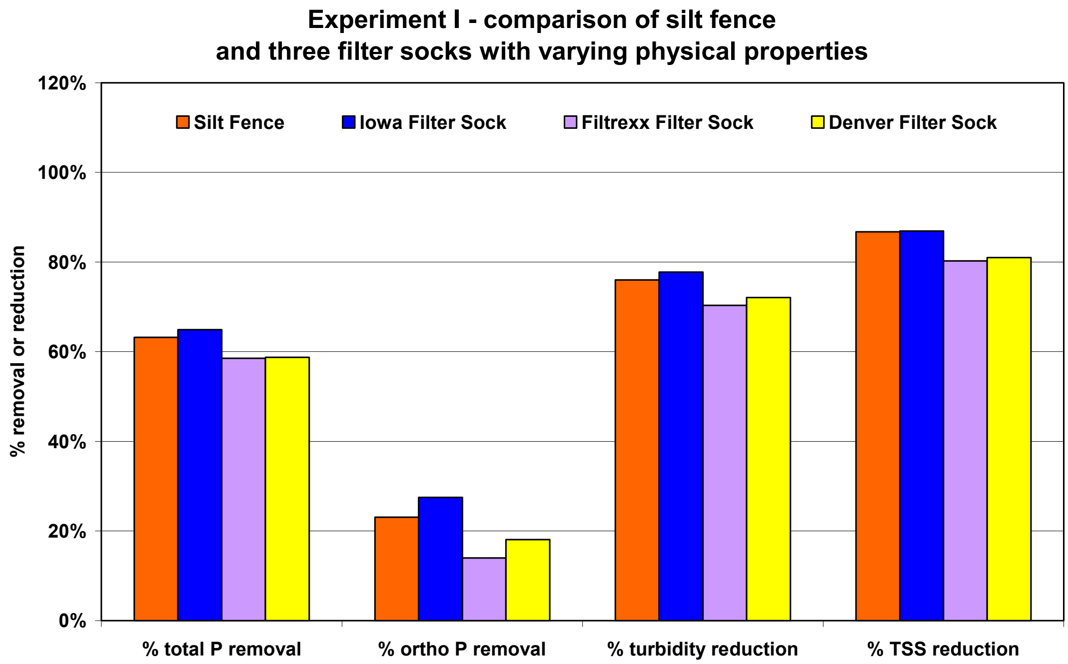

Figure 1. Percent Removal and Reduction for Experiment I.

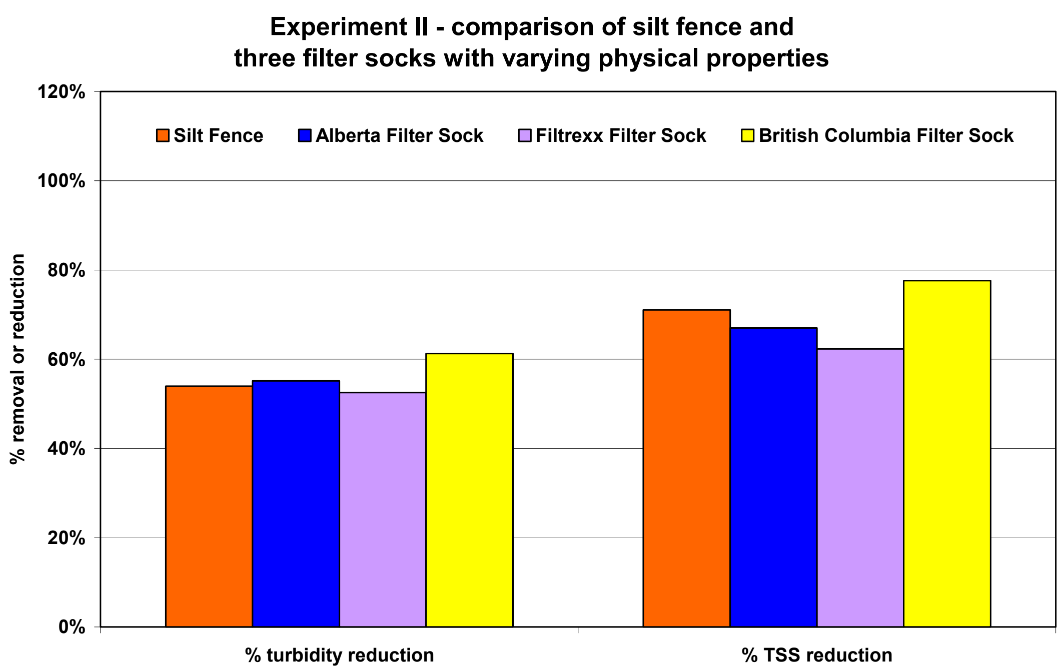

Figure 2. Percent Removal and Reduction for Experiment II.

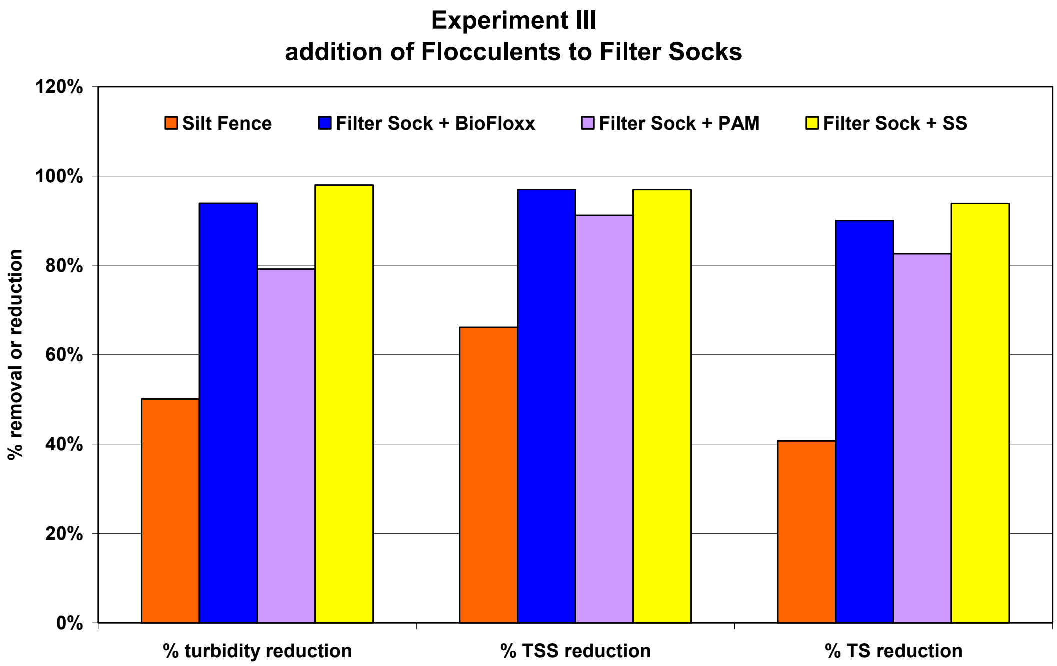

Figure 3. Percent Removal and Reduction for Experiment III.

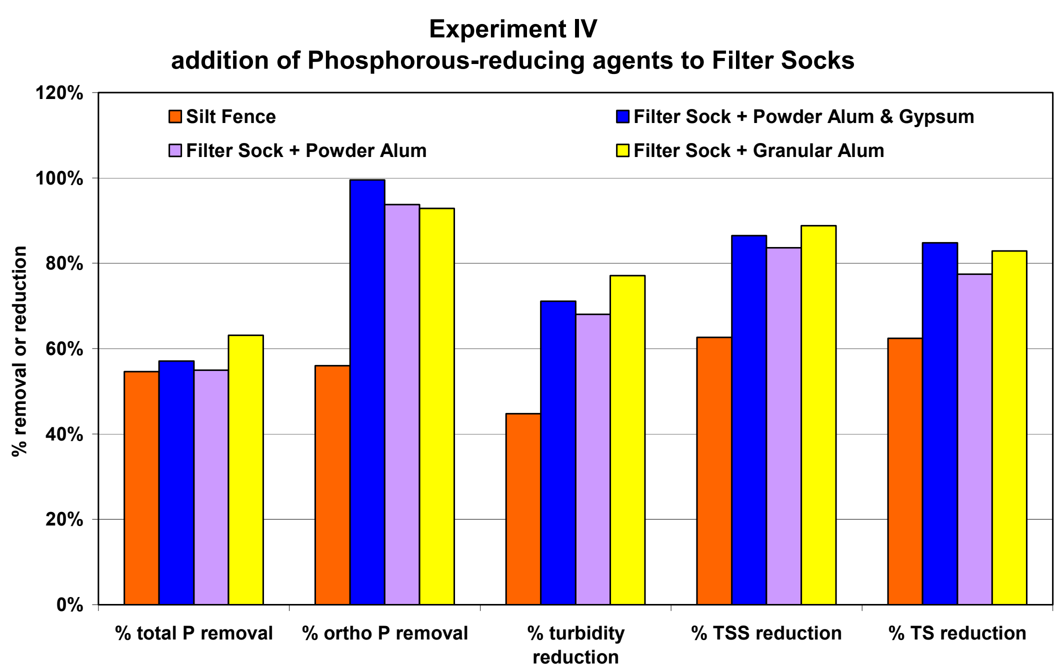

Figure 4. Percent Removal and Reduction for Experiment IV.

Table 5. Mean Values and % Removal/Reduction for all Experimental Treatments

		Total Suspended Solids (TSS)		Turbidity		NO2 + NO3		Total P		Soluble P		Total P w/fertilizer added		Soluble P w/fertilizer added		Flow Rate		
treatment	Exp #	(mg/L)	% removal	(NTU)	% reduction	(mg/L)	% removal	(mg/L)	% removal	(mg/L)	% removal	(mg/L)	% removal	(mg/L)	% removal	L/min /linear ft.	Gal/min /linear ft.	% difference
Bare soil (control)	I	70.40		36688		1.40		31.18		0.438						0.2752	0.0727	
Bare soil (control)	II	49.34		31504												0.3699	0.0977	
Bare soil (control)	III	61.56		32793												0.4260	0.1126	
Bare soil (control)	IV			19343								81.56		36.58		0.4157	0.1098	
Silt Fence	I	9.34	86.73%	8805	76.00%	1.68		11.46	63.24%	0.337	23.05%					0.1950	0.0515	29.16%
Silt Fence	II	14.30	71.03%	14508	53.95%											0.3499	0.0924	5.43%
Silt Fence	III	20.85	66.13%	16371	50.08%											0.4064	0.1074	4.61%
Silt Fence	IV			10687	44.75%							37.02	54.61%	16.10	56.00%	0.3253	0.0859	21.74%
Filter Sock Iowa	I	9.21	86.92%	8165	77.75%	1.39	0.87%	10.94	64.92%	0.317	27.48%					0.2397	0.0633	12.92%
Filter Sock Filtrexx	I															0.2705	0.0715	1.73%
Filter Sock Denver	I															0.2687	0.0710	2.37%
Filter Sock Alberta	II	16.30	66.97%	14128	55.15%											0.2971	0.0785	19.68%
Filter Sock Filtrexx	II	18.60	62.31%	14954	52.53%											0.3239	0.0856	12.45%
Filter Sock British Columbia	II	11.05	77.60%	12205	61.26%											0.2888	0.0763	21.93%
Filter Sock + BioFloxx	III	1.87	96.96%	2003	93.89%											0.2827	0.0747	33.64%
Filter Sock + PAM	III	5.41	91.22%	6835	79.16%											0.2959	0.0782	30.54%
Filter Sock + SS	III	1.88	96.95%	659	97.99%											0.2262	0.0598	46.89%
Filter Sock + Alum & Gypsum	IV											34.99	57.10%	0.17	99.54%	0.3338	0.0882	19.70%
Filter Sock + Alum (powder)	IV											36.75	54.95%	2.29	93.75%	0.3550	0.0938	14.60%
Filter Sock + Alum (granular)	IV											30.07	63.13%	2.61	92.87%	0.3494	0.0923	15.94%

Table 5. Total Mass and % Reduction/Removal for all Experimental Treatments

		Total Suspended Solids (TSS)		P factor	Total P w/fertilizer added		Soluble P w/fertilizer added	
treatment	Exp #	(g)	% removal	% reduction	(mg)	% removal	(mg)	% removal
Bare soil (control)	I	753.0						
Bare soil (control)	II	605.5						
Bare soil (control)	III	823.1						
Bare soil (control)	IV				676.1		229.9	
Silt Fence	I	81.9	89.1%	0.11				
Silt Fence	II	155.4	74.3%	0.26				
Silt Fence	III	234.6	71.5%	0.29				
Silt Fence	IV				323.8	52.1%	120.9	47.4%
Filter Sock Iowa	I	77.3	89.7%	0.10				
Filter Sock Filtrexx	I	129.7	82.8%	0.17				
Filter Sock Denver	I	135.0	82.1%	0.18				
Filter Sock Alberta	II	162.2	73.2%	0.27				
Filter Sock Filtrexx	II	192.2	68.3%	0.32				
Filter Sock British Columbia	II	103.6	82.9%	0.17				
Filter Sock + Biostarch	III	17.8	97.8%	0.02				
Filter Sock + PAM	III	49.8	94.0%	0.06				
Filter Sock + Silt Stop	III	14.6	98.2%	0.02				
Filter Sock + Alum & Gypsum	IV				261.7	61.3%	1.5	99.4%
Filter Sock + Alum (powder)	IV				274.6	59.4%	13.9	93.9%
Filter Sock + Alum (granular)	IV				233.1	65.5%	18.6	91.9%

Conclusion

Additional experiments are planned to evaluate the sediment and nutrient removal abilities of the filter socks. Upcoming experiments will evaluate the effectiveness of the filter socks on a larger scale, also under simulated rainfall conditions.

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