US Environmental Protection Agency

National Pollutant Discharge Elimination System (NPDES)

Construction Site Stormwater Runoff Control

Uncontrolled stormwater runoff from construction sites can significantly impact rivers, lakes and estuaries. Sediment in waterbodies from construction sites can reduce the amount of sunlight reaching aquatic plants, clog fish gills, smother aquatic habitat and spawning areas, and impede navigation.


Poorly maintained BMPs can result in significant quantities of sediment being discharged to storm drains.

Phase II MS4s are required to develop a program to reduce pollutants in stormwater runoff to the MS4 for construction sites disturbing one or more acres. This primarily includes developing:

- An ordinance,
- Requirements to implement erosion and sediment control BMPs,
- Requirements to control other waste at the construction site,
- Procedures for reviewing construction site plans,
- Procedures to receive and consider information submitted by the public, and
- Procedures for inspections and enforcement of stormwater requirements at construction sites.

In addition to the stormwater requirements that Phase II MS4s place on construction sites, construction operators must also apply for NPDES permit coverage if their project disturbs at least one acre and discharges to a waterbody. A description of these requirements is available at EPA's stormwater construction website.

Additional information on this minimum measure, including the stormwater Phase II regulatory requirements for construction site runoff control and a fact sheet on the construction minimum measure [PDF - 245 KB - 4 pp], is also available.

Key BMPs and Resources:

MS4s addressing the construction minimum measure should focus on the following four key BMPs to help them in developing a stormwater construction program. The additional BMPs in the next section below will help construction operators comply with the MS4's requirements.

Local Ordinances for Construction Site Runoff Control BMP fact sheet
Construction Phase Plan Review BMP fact sheet
Contractor Training and Certification BMP fact sheet
Municipal Construction Inspection Program BMP fact sheet
Coming Soon! Construction SWPPP Guide – EPA is developing a guide to help small construction

operators develop stormwater pollution prevention plans to comply with their NPDES construction permit requirements.

Construction Industry Compliance Assistance website EXIT Disclaimer provides plain language information on environmental rules, including stormwater, for the construction industry.

BMPs: **Municipal Program Oversight**

Construction Phase Plan Review

Contractor Training and Certification

Local Ordinances for Construction Site Runoff Control

Municipal Construction Inspection Program

Construction Site Planning and Management

Construction Sequencing

Construction Site Operator BMP Inspection and Maintenance

Land Grading

Preserving Natural Vegetation

Erosion Control

Chemical Stabilization

→ Compost Blankets

Dust Control

Geotextiles

Gradient Terraces

Mulching

Riprap

Seeding

Sodding

Soil Retention

Soil Roughening

Temporary Slope Drain

Temporary Stream Crossings

Wind Fences and Sand Fences

Runoff Control

Check Dams

Grass-Lined Channels

Permanent Slope Diversions

Temporary Diversion Dikes

Sediment Control

Brush Barrier

→ Compost Filter Berms

→ Compost Filter Socks

Construction Entrances

Fiber Rolls

Filter Berms

Sediment Basins and Rock Dams

Sediment Filters and Sediment Chambers

Sediment Traps

Silt Fences

Storm Drain Inlet Protection

Straw or Hay Bales

Vegetated Buffers

Good Houskeeping/Materials Management

Concrete Washout

General Construction Site Waste Management

Spill Prevention and Control Plan

Vehicle Maintenance and Washing Areas at Construction Sites

EPA Internet Resources:

Stormwater case studies on municipal construction programs includes case studies of how a Phase I or Phase II community has implemented the construction requirements.

EPA 1992 Guidance on Developing Pollution Prevention Plans and BMPs for Construction Activities describes the steps necessary to develop a stormwater pollution prevention plan for construction activity.

Stormwater outreach materials for the construction industry including brochures in English and Spanish, and a poster are available for download.

Construction Industry Compliance Assistance Web Site provides plain language information on environmental rules, including stormwater, for the construction industry.

Model Ordinances including erosion and sediment control ordinances, are available from EPA's Nonpoint Source Program.

Urban Management Measures Guidance Chapter 5 focuses on construction site erosion, sediment, and chemical control.

Other Internet Resources:

Minnesota Pollution Control Agency stormwater guidance:

Stormwater Construction Inspection Guide [PDF - 5.77 MB - 35 pp] describes how municipal inspectors should conduct construction site inspections.

Stormwater Compliance Assistance Tool Kit for Small Construction Operators [PDF - 500 KB - 44 pp] provides guidance to help small construction operators comply with their stormwater requirements.

Kentucky Erosion Prevention and Sediment Control Field Guide is available for download in three parts from the Kentucky Division of Water's Stormwater website .

2005 Stormwater Management Manual for Western Washington: Volume II -- Construction Stormwater Pollution Prevention describes 12 elements of construction SWPPPs and BMP standards and specifications.

US Environmental Protection Agency

National Pollutant Discharge Elimination System (NPDES)

Compost Blankets

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Erosion Control

Description

A compost blanket is a layer of loosely applied compost or composted material that is placed on the soil in disturbed areas to control erosion and retain sediment resulting from sheet-flow runoff. It can be used in place of traditional sediment and erosion control tools such as mulch, netting, or chemical stabilization. When properly applied, the erosion control compost forms a blanket that completely covers the ground surface. This blanket prevents stormwater erosion by (1) presenting a more permeable surface to the oncoming sheet flow, thus facilitating infiltration; (2) filling in small rills and voids to limit channelized flow; and (3) promoting establishment of vegetation on the surface. Composts used in compost blankets are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids, and manure.

Application of a 2 inch-thick compost blanket to a 1:1 rock slope using a pneumatic blower (Austin, Texas, 2002). Source: McCoy, Texas Commission on Environmental Quality (TECQ), 2005

Compost blankets can be placed on any soil surface: rocky, frozen, flat, or steep. The method of application and the depth of the compost applied will vary depending upon slope and site conditions. The compost blanket can be vegetated by incorporating seeds into the compost before it is placed on the disturbed area (recommended method) or the seed can be broadcast onto the surface after installation (Faucette and Risse, 2001).

In general, compost-based erosion and sediment control systems have several advantages over more traditional stormwater best management practices (BMPs) such as geotextile blankets. Advantages provided by compost blankets include the following (Alexander, 2003; Faucette, 2004):

- The compost retains a large volume of water, which helps reduce runoff, prevents or reduces sheet and rill erosion, and aids in establishing vegetation in the blanket.
- The compost blanket acts as a buffer to absorb rainfall energy, which prevents soil compaction and crusting and facilitates rainfall infiltration.
- Compost blankets facilitate plant growth by capturing and retaining moisture and providing a suitable microclimate and nutrients for seed germination.
- The compost stimulates microbial activity, which increases decomposition of organic matter, increases nutrient availability for plants, and improves the soil structure.
- Compost can remove pollutants, such as heavy metals; nitrogen; phosphorus; oil and grease; and fuel, from stormwater, thus improving downstream water quality (W&H Pacific, 1993; USEPA, 1998).

Applicability

Compost blankets are most effective when applied on slopes between 4:1 and 1:1, such as stream banks; road embankments; and construction sites, where stormwater runoff occurs as sheet flow. Compost blankets are not applicable for locations with concentrated flow. Because the compost is applied to the ground surface and not incorporated into the soil, a compost blanket provides excellent erosion and sediment control on difficult terrain—including steep, rocky slopes.

Siting and Design Considerations

Compost Quality: Compost quality is an important consideration when designing a compost blanket. Use of sanitized, mature compost will ensure that the compost blanket performs as designed and has no identifiable feedstock constituents or offensive odors. The compost used in compost blankets should meet all local, state, and Federal quality requirements. Biosolids compost must meet the Standards for Class A biosolids outlined in 40 Code of Federal Regulations (CFR) Part 503. The U.S. Composting Council (USCC) certifies compost products under its Seal of Testing Assurance (STA) Program. Compost producers whose products have been certified through the STA Program provide customers with a standard product label that allows comparison between compost products. The current STA Program requirements and testing methods are posted on the USCC EXIT Disclaimer website.

The nutrient and metal content of some composts are higher than some topsoils. This, however, does not necessarily translate into higher metals and nutrient concentrations or loads in stormwater runoff. A recent study by Glanville, et al. (2003) compared the stormwater runoff water quality from compost- and topsoil-treated plots. They found that although the composts used in the study contained statistically higher metal and nutrient concentrations than the topsoils used, the total masses of nutrients and metals in the runoff from the compost-treated plots were significantly less than plots treated with topsoil. Likewise, Faucette et al. (2005) found that nitrogen and phosphorus loads from hydroseed and silt fence treated plots were significantly greater than plots treated with compost blankets and filter berms. In areas where the receiving waters contain high nutrient levels, the site operator should choose a mature, stable compost that is compatible with the nutrient and pH requirements of the selected vegetation. This will ensure that the nutrients in the composted material are in organic form and are therefore less soluble and less likely to migrate into receiving waters.

The American Association of State Highway Transportation Officials (AASHTO) and many individual state Departments of Transportation (DOTs) have issued specifications for compost blankets (AASHTO, 2003; USCC, 2001). These specifications describe the quality and particle size distribution of compost to be used in compost blankets. The compost blanket media parameters developed for AASHTO specification MP 10-03 are shown in Table 1 as an example (Alexander, 2003). Research on these parameters continues to evolve; therefore, the DOT or Department of Environmental Quality (or similar designation) for the state where the compost blanket will be installed should be contacted to obtain any applicable specifications or compost testing recommendations.

Table 1. Example Compost Blanket Media Parameters

Parameters[1,4]	Units of Measure	Surface to be Vegetated	Surface to be left Unvegetated
pH[2]	pH units	5.0 – 8.5	N/A
Soluble salt concentration (electrical conductivity)[2]	dS/m (mmhos/cm)	Maximum 5	Maximum 5

Moisture content	%, wet weight basis	30 – 60	30 – 60
Organic matter content	%, dry weight basis	25 – 65	25 – 100
Organic matter content	% passing a selected mesh size, dry weight basis	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 – 100% passing - ¾ in. (19 mm), 65 – 100% passing - ¼ in. (6.4 mm), 0 – 75% passing Maximum particle length of 6 in (152 mm)	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 – 100% passing - ¾ in. (19 mm), 65 –100% passing - ¼ in. (6.4 mm), 0 – 75% passing Maximum particle length of 6 in (152 mm)
Stability[3] Carbon dioxide evolution rate	mg CO_2–C per g organic matter per day	<8	N/A
Physical contaminants (manmade inerts)	%, dry weight basis	<1	<1

Source: Alexander, 2003

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost [USCC EXIT Disclaimer].
[2] Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. When specifying the establishment of any plant or turf species, it is important to understand its pH and soluble salt requirements and how they relate to the compost in use.
[3] Stability/maturity rating is an area of compost science that is still evolving; therefore, other test methods could be considered. Also, users should not base compost quality conclusions on the result of a single stability/maturity test.
[4] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Siting and Design: Specific site characteristics, such as existing vegetation; climate; structural attributes of the site; annual rainfall; and rainfall erosivity, are considered when determining the appropriate depth for the compost blanket. Erosivity is the term used to describe the potential for soil to erode from disturbed, unvegetated earth into waterways during storms. Example compost blanket depths for various rainfall scenarios developed for AASHTO specification MP 10-03 are shown in Table 2 (Alexander, 2003).

Installation: The compost should be applied to the soil surface in a uniform thickness, usually between 1 and 3 inches thick. A typical application depth is 2 inches (Glanville et al., 2003). The compost can be distributed by hand using a shovel or by mechanical means such as a spreader unit (e.g., bulldozer or manure spreader) or pneumatic blower. The compost blanket should extend at least 3 feet over the shoulder of the slope to ensure that stormwater runoff does not flow under the blanket (Alexander, 2003). The pneumatic blower is best for applying compost to steep, rocky, or difficult to reach locations because the worker can stand below the slope and blow the compost up onto the slope in an even thickness or use a vehicle to reach higher slopes (see photograph on page 1). Very coarse compost should be avoided on slopes that will be landscaped or seeded, as it will make planting and crop establishment more difficult. Thicker and/or coarser compost blankets are recommended for areas with higher annual precipitation or rainfall intensity, and coarser compost is recommended for areas subject to wind erosion (Alexander, 2003).

Table 2. Example Compost Blanket Depths for Various Rainfall Rates

Annual Rainfall/ Flow Rate	Total Precipitation (Rainfall Erosivity Index)	Compost Blanket Depth (Vegetated Surface)	Compost Blanket Depth (Unvegetated Surface)
Low	1 – 25 in. (20 – 90)	½ – ¾ in. (12.5 – 19 mm)	1 in. – 1½ in. (25 – 37.5 mm)
Average	26 – 50 in. (91 – 200)	¾ – 1 in. (19 – 25 mm)	1½ in – 2 in. (37 – 50 mm)
High	>51 in. (>201)	1 – 2 in. (25 – 50 mm)	2 – 4 in. (50 – 100 mm)

Source: Alexander, 2003

Although seed can be broadcast on the compost blanket after installation, it is typically incorporated into the compost before it is applied, to ensure even distribution of the seed throughout the compost and to reduce the risk of the seed being washed from the surface of the compost blanket by stormwater runoff. In some applications (e.g., on a steep slope), better sediment and erosion control can be achieved by using the compost blanket in conjunction with another BMP, such as lock-down netting, compost filter berms, or compost filter socks. Lock-down netting will help hold the compost in place, while compost filter berms or compost filter socks placed across the slope will slow down the flow of water. Compost filter berms or filter socks can also be placed at the top and bottom of the embankment.

Limitations

Limitations for compost blanket applications are dependent on the site specifications. Compost blankets are not generally used on slopes greater than 2:1 or in areas where concentrated runoff or water flow will occur (Glanville et al., 2003). They can, however, be used on steeper slopes (1:1) if netting or confinement systems are used in conjunction with the compost blanket to further stabilize the compost and the slope or if the compost particle size and compost depth are specially designed for the application.

Maintenance Considerations

The compost blanket should be checked periodically and after each major rainfall. If areas of the compost blanket have washed out, another layer of compost should be applied. In some cases, it may be necessary to add another stormwater BMP, such as a compost filter sock or silt fence. On slopes greater than 2:1, establishing thick, permanent vegetation as soon as possible is the key to successful erosion and sediment control. Restricting or eliminating pedestrian traffic on such areas is essential (Faucette and Ruhlman, 2004).

Effectiveness

Numerous studies conducted by a variety of universities and State DOTs have reported the effectiveness of compost blankets; only a few of the recent studies are cited here. A University of Georgia research trial (Faucette and Risse, 2002) reported that correctly applied compost blankets provide almost 100 percent soil surface coverage, while other methods (e.g., straw mats and mulches) provide only 70 to 75 percent coverage. Uniform soil cover by the compost blanket is a key component to effective erosion and sediment control because it helps maintain sheet flow and prevents stormwater from forming rills under the blanket. Compost blankets also help protect the structural stability of the slope, particularly when vegetated (BioCycle, 2002).

An Iowa State University study (Glanville et al., 2003), sponsored by the Iowa Department of Natural Resources and Iowa DOT, compared compost-treated road embankments to conventionally treated embankments (i.e., topsoil added to surface). The study exposed the test plots to high intensity rainfall (4 inches/hour) lasting at least 30 minutes. The results showed that the 2- and 4-inch thick compost blankets reduced runoff from the embankment by 80 percent. The erosion rate from the compost blanket was less than 1 percent of that from the non-composted areas, and weed growth on compost-treated areas was approximately 25 percent of that on untreated areas.

Cost Considerations

The cost of a compost blanket is comparable to a straw mat and less expensive than a geotextile blanket. Faucette (2004) reports that the cost of a compost blanket in Georgia ranges from $0.83 to $4.32 per cubic yard installed. The actual cost will depend upon the quality of compost required and the thickness of the application. According to the TCEQ (McCoy, 2005), a 1-inch thick unseeded compost blanket costs $0.99 per square yard installed, and a 1-inch thick seeded compost blanket costs $1.08 per square yard in Texas.

References

AASHTO. 2003. *Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Designation M10-03, Compost for Erosion/Sediment Control (Compost Blankets), Provisional*, American Association of State Highway Transportation Officials, Washington, D.C.

Alexander, R. 2003. *Standard Specifications for Compost for Erosion/Sediment Control*, developed for the Recycled Materials Resource Center , University of New Hampshire, Durham, New Hampshire. Available at [www.alexassoc.net EXIT Disclaimer].

Faucette, et al. 2005. *Evaluation of Stormwater from Compost and Conventional Erosion Control Practices in Construction Activities,* Journal of Soil and Water Conservation, 60:6, 288-297.

Faucette, B. and M. Ruhlman. 2004. *Stream Bank Stabilization Utilizing Compost*. BioCycle, January 2004, page 24.

Faucette, B. and M. Risse. 2002. *Controlling Erosion with Compost and Mulch*. BioCycle, June 2002, pages 26–28.

Faucette, B. 2004. *Evaluation of Environmental Benefits and Impacts of Compost and Industry Standard Erosion and Sediment Controls Measures Used in Construction Activities*, Dissertation, Institute of Ecology, University of Georgia, Athens, Georgia.

Glanville et al. 2003. *Impacts of Compost Blankets on Erosion Control, Revegetation, and Water Quality at Highway Construction Sites in Iowa*, T. Glanville, T. Richard, and R. Persyn, Agricultural and Biosystems Engineering Department, Iowa State University of Science and Technology, Ames, Iowa.

McCoy, S. 2005. Filter Sock Presentation provided at *Erosion, Sediment Control and Stormwater Management with Compost BMPs Workshop*, U.S. Composting Council 13 th Annual Conference and Trade Show, January 2005, San Antonio, Texas.

Risse, M. and B. Faucette. 2001. *Compost Utilization for Erosion Control*, University of Georgia, Cooperative Extension Service, Athens, Georgia.

USCC. 2001. *Compost Use on State Highway Applications*, U.S. Composting Council, Washington, D.C.

USEPA. 1998. *An Analysis of Composting as an Environmental Remediation Technology*. U.S. Environmental Protection Agency, Solid Waste and Emergency Response (5305W), EPA530-R-98-008, April 1998.

W&H Pacific. 1993. *Demonstration Project Using Yard Debris Compost for Erosion Control, Final Report,* presented to Metropolitan Service District, Portland, Oregon.

Compost Filter Berms

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Sediment Control

Description

A compost filter berm is a dike of compost or a compost product that is placed perpendicular to sheet flow runoff to control erosion in disturbed areas and retain sediment. It can be used in place of a traditional sediment and erosion control tool such as a silt fence. The compost filter berm, which is trapezoidal in cross section, provides a three-dimensional filter that retains sediment and other pollutants (e.g., suspended solids, metals, oil and grease) while allowing the cleaned water to flow through the berm. Composts used in filter berms are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids, and manure.

Vegetated compost filter berm. Note sediment on upstream side of berm and clear water on downstream side. Source: S. McCoy, Texas Commission on Environmental Quality.

Compost filter berms are generally placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. A filter berm also can be used as a check dam in small drainage ditches. The berms can be vegetated or unvegetated. Vegetated filter berms are normally left in place and provide long-term filtration of stormwater as a post-construction best management practice (BMP). Unvegetated berms are often broken down once construction is complete and the compost is spread around the site as a soil amendment or mulch.

Filter berms, in general, provide an effective physical barrier in sheet flow conditions; however, the use of compost in the filter berm provides additional benefits. These benefits include the following:

- The compost retains a large volume of water, which helps prevent or reduce rill erosion and aids in establishing vegetation on the berm.
- The mix of particle sizes in the compost filter material retains as much or more sediment than traditional perimeter controls, such as silt fences or hay bale barriers, while allowing a larger volume of clear water to pass through the berm. Silt fences often become clogged with sediment and form a dam that retains stormwater, rather than letting the filtered stormwater pass through.
- In addition to retaining sediment, compost can retain pollutants, such as heavy metals, nitrogen, phosphorus, oil and grease, fuel, herbicides, pesticides, and other potentially hazardous substances, from stormwater.improving water quality downstream of the berm (USEPA, 1998).
- Nutrients and hydrocarbons adsorbed and/or trapped by the compost filter can be naturally cycled and decomposed through bioremediation by microorganisms commonly found in the compost matrix (USEPA, 1998).

Applicability

Compost filter berms are applicable to construction sites with relatively small drainage areas, where stormwater runoff occurs as sheet flow. Common industry practice is to use compost filter berms in drainage areas that do not exceed 0.25 acre per 100 feet of berm length and where flow does not typically exceed 1 cubic foot per second (see Siting and Design Considerations discussion for more detail). Compost filter berms can be used on steeper slopes with faster flows if they are spaced more closely or used in combination with other stormwater BMPs such as compost blankets or silt fences.

Siting and Design Considerations

Compost Quality: Compost quality is an important consideration when designing a compost filter berm. Use of sanitized, mature compost will ensure that the compost filter berm performs as designed and has no identifiable feedstock constituents or offensive odors. The compost used in filter berms should meet all local, state, and Federal quality requirements. Biosolids compost must meet the Standards for Class A biosolids outlined in 40 Code of Federal Regulations (CFR) Part 503. The U.S. Composting Council (USCC) certifies compost products under its Seal of Testing Assurance (STA) Program. Compost producers whose products have been certified through the STA Program provide customers with a standard product label that allows comparison between compost products. The current STA Program requirements and testing methods are posted on the USCC EXIT Disclaimer website.

The nutrient and metal content of some composts are higher than some topsoils. This, however, does not necessarily translate into higher metals and nutrient concentrations or loads in stormwater runoff. A recent study by Glanville, et al. (2003) compared the stormwater runoff water quality from compost- and topsoil-treated plots. They found that although the composts used in the study contained statistically higher metal and nutrient concentrations than the topsoils used, the total masses of nutrients and metals in the runoff from the compost-treated plots were significantly less than plots treated with topsoil. Likewise, Faucette et al. (2005) found that nitrogen and phosphorus loads from hydroseed and silt fence treated plots were significantly greater than plots treated with compost blankets and filter berms. In areas where the receiving waters contain high nutrient levels, the site operator should choose a mature, stable compost that is compatible with the nutrient and pH requirements of the selected vegetation. This will ensure that the nutrients in the composted material are in organic form and are therefore less soluble and less likely to migrate into receiving waters.

The American Association of State Highway Transportation Officials (AASHTO) and many individual state Departments of Transportation (DOTs) have issued specifications for filter berms (AASHTO, 2003; USCC, 2001). These specifications describe the quality and particle size distribution of compost to be used in filter berms, as well as the size and shape of the berm for different scenarios. The filter berm media parameters developed for AASHTO specification MP 9-03 are shown in Table 1 as an example (Alexander, 2003). Research on these parameters continues to evolve; therefore, the DOT or Department of Environmental Quality (or similar designation) for the state where the filter berm will be installed should be contacted to obtain any applicable specifications or compost testing recommendations.

Design: Filter berms installed to control erosion and sediment on a slope or near the base of a slope are trapezoidal in cross section, with the base generally twice the height of the berm. The height and width of the berm will vary depending upon the precipitation and the rainfall erosivity index (EPA, 2001) of the site. Example compost filter berm dimensions for various rainfall scenarios developed for AASHTO specification MP 9-03 are shown in Table 2 (Alexander, 2003). Example filter berm dimensions based on the site slope and slope length developed by the Oregon Department of Environmental Quality (ODEQ) are shown in Table 3 (ODEQ, 2004).

The compost filter berm dimensions should be modified based on site-specific conditions, such as soil characteristics, existing vegetation, site slope, and climate, as well as project-specific requirements. Coarser compost products are generally used in regions subject to high rainfall or wind erosion.

Table 1. Example Filter Berm Media Parameters

Parameters[1,4]	Units of Measure	Berm to be Vegetated	Berm to be left Unvegetated
pH[2]	pH units	5.0.8.5	Not applicable
Soluble salt concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 5	Not applicable
Moisture content	%, wet weight basis	30.60	30.60
Organic matter content	%, dry weight basis	25.65	25.100
Particle size	% passing a selected mesh size, dry weight basis	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 . 100% passing - 0.75 in. (19 mm), 70 . 100% passing - 0.25 in. (6.4 mm), 30 . 75% passing Maximum particle size length of 6 in (152 mm) Avoid compost with less than 30% fine particle (1mm) to achieve optimum reduction of total suspended solids No more than 60% passing 0.25 in (6.4 mm) in high rainfall/flow rate situations	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 . 100% passing - 0.75 in. (19 mm), 70 . 100% passing - 0.25 in. (6.4 mm), 30 . 75% passing Maximum particle size length of 6 in (152 mm) Avoid compost with less than 30% fine particle (1mm) to achieve optimum reduction of total suspended solids No more than 60% passing 0.25 in (6.4 mm) in high rainfall/flow rate situations
Stability[3] Carbon dioxide evolution rate	mg CO_2.C per gram of organic matter per day	<8	Not applicable
Physical contaminants (manmade inerts)	%, dry weight basis	<1	<1

Source: Alexander, 2003

[1] Recommended test methodologies are provided in [Test Methods for the Evaluation of Composting and Compost EXIT Disclaimer].
[2] Each plant species requires a specific pH range and has a salinity tolerance rating.
[3] Stability/maturity rating is an area of compost science that is still evolving, and other test methods should be considered. Compost quality decisions should be based on more than one stability/maturity test.
[4] Landscape architects and project engineers may modify the above compost specification ranges based on specific field conditions and plant requirements.

Table 2. Example Compost Filter Berm Dimensions for Various Rainfall Scenarios

Annual Rainfall/ Flow Rate	Precipitation/year (Rainfall Erosivity Index)	Berm Dimensions (height x width)
Low	1 . 25 in. (20 . 90)	1 ft x 2 ft to 1.5 ft x 3 ft (30 cm x 60 cm to 45 cm x 90 cm)
Average	26 . 50 in. (91 . 200)	1 ft x 2 ft to 1.5 ft x 3 ft (30 cm x 60 cm to 45 cm x 90 cm)
High	e 51 in. (e 201)	1.5 ft x 3 ft to 2 ft x 4 ft (45 cm x 90 cm to 60 cm x 120 cm)

Source: Alexander, 2003

Table 3. Example Compost Filter Berm Dimensions Based on Slope and Slope Length

Slope	Slope Length	Berm Dimensions (height x width)
<50:1	250 ft	1 ft x 2 ft
50:1 . 10:1	125 ft	1 ft x 2 ft
10:1 . 5:1	100 ft	1 ft x 2 ft
3:1 . 2:1	50 ft	1.3 ft x 2.6 ft
>2:1	25 ft	1.5 ft x 3 ft

Source: ODEQ, 2004

Siting: For sites in high rainfall areas or where there are severe grades or long slopes, larger dimension berms should be used. The project engineer may also consider placing berms at the top and base of the slope, constructing a series of berms down the profile of the slope (15 to 25 feet apart), or using filter berms in conjunction with a compost blanket.

Installation: The compost berm can be installed by hand; by using a backhoe, bulldozer, or grading blade; or by using specialized equipment such as a pneumatic blower or side discharge spreader with a berm attachment. The compost should be uniformly applied to the soil surface, compacted, and shaped to into a trapezoid. Compost filter berms can be installed on frozen or rocky ground. The filter berm may be vegetated by hand, by incorporating seed into the compost prior to installation (usually done when the compost is installed using a pneumatic blower or mixing truck with a side discharge), or by hydraulic seeding following berm construction. Proper installation of a compost filter berm is the key to effective sediment control.

Limitations

Compost filter berms can be installed on any type of soil surface; however, heavy vegetation should be cut down or removed to ensure that the compost contacts the ground surface. Filter berms are not suitable for areas where large amounts of concentrated runoff are likely, such as streams, ditches, or waterways, unless the drainage is small and the flow rate is relatively low.

Maintenance Considerations

Compost filter berms should be inspected regularly, as well as after each rainfall event, to ensure that they are intact and the area behind the berm is not filled with silt. Accumulated sediments should be removed from behind the berm when the sediments reach approximately one third the height of the berm. Any areas that have been washed away should be replaced. If the berm has experienced significant washout, a filter berm alone may not be the appropriate BMP for this area. Depending upon the site-specific conditions, the site operator could remedy the problem by increasing the size of the filter berm or adding another BMP in this area, such as an additional compost filter berm or compost filter sock, a compost blanket, or a silt fence.

Effectiveness

Numerous qualitative studies have reported the effectiveness of compost filter berms in removing settleable solids, total suspended solids, and various organic and inorganic contaminants from stormwater. These studies have consistently shown that compost filter berms are at least as effective as other traditional erosion and sediment control BMPs in controlling sediment; however, the results of the studies varied depending upon the site conditions. One quantitative study conducted in Portland, Oregon (W&H Pacific, 1993) compared the effectiveness of a silt fence and a mixed yard debris compost filter berm to a control plot during five storm events. The study found that the filter berm was over 90 percent effective in removing settleable and total suspended solids when compared to the control plot and was approximately 66 percent more effective than the silt fence. Another quantitative study performed by the Snohomish County, Washington, Department of Planning and Development Services (Caine, 2001) showed no decrease in turbidity with a silt fence but a 67 percent reduction in turbidity using a compost filter berm.

Cost Considerations

The TCEQ reports that compost filter berms cost $1.90 to $3.00 per linear foot when used as a perimeter control and $3 to $6 per linear foot when used as a check dam (McCoy, 2005). The ODEQ reports that compost filter berms cost approximately 30 percent less to install than silt fences (Juries, 2004). These costs do not include the cost of removal and disposal of the silt fence or the cost of dispersing the compost berm once construction activities are completed. The cost to install a compost filter berm will vary, depending upon the availability of the required quality of compost in an area.

References

Alexander, R. 2003. *Standard Specifications for Compost for Erosion/Sediment Control*, developed for the Recycled Materials Resource Center, University of New Hampshire, Durham, New Hampshire. Available at [www.alexassoc.net EXIT Disclaimer].

Alexander, R. 2001. *Compost Use on State Highway Applications,* Composting Council Research and Education Fund and U.S. Composting Council, Harrisburg, Pennsylvania.

AASHTO. 2003 *Standard Specifications for Transportation materials and Methods of Sampling and Testing, Designation MP-9, Compost for Erosion/Sediment Control (Filter Berms), Provisional,* American Association of State Highway Transportation Officials, Washington, D.C.

Caine, E. 2001. *Quilceda-Allen Watershed Erosion Control Program, Water Quality Monitoring Report*, Snohomish County, Washington, Department of Planning and Development Services, Building Division.

EPA. 2001. *Stormwater Phase II Final Rule, Fact Sheet 3.1, Construction Rainfall Erosivity Waiver*, EPA 833-F-00-014, U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Faucette, et al. 2005. *Evaluation of Stormwater from Compost and Conventional Erosion Control Practices in Construction Activities,* Journal of Soil and Water Conservation, 60:6, 288-297.

Glanville et al. 2003. *Impacts of Compost Blankets on Erosion Control, Revegetation, and Water Quality at Highway Construction Sites in Iowa*, T. Glanville, T. Richard, and R. Persyn, Agricultural and Biosystems Engineering Department, Iowa State University of Science and Technology, Ames, Iowa.

Juries, D. 2004. *Environmental Protection and Enhancement with Compost,* Oregon Department of Environmental Quality, Northwest Region.

McCoy, S. 2005. Presentation at *Erosion, Sediment Control and Stormwater Management with Compost BMPs Workshop*, U.S. Composting Council 13 th Annual Conference and Trade Show, January 2005, San Antonio, Texas.

ODEQ. 2004. *Best Management Practices for Stormwater Discharges Associated with Construction Activity, Guidance for Eliminating or Reducing Pollutants in Stormwater Discharges,* Oregon Department of Environmental Quality, Northwest Region.

Risse, M. and B. Faucette. 2001. *Compost Utilization for Erosion Control*, University of Georgia, Cooperative Extension Service, Athens, Georgia.

USCC, 2001. *Compost Use on State Highway Applications*, U.S. Composting Council, Washington, D.C.

USEPA. 1998. *An Analysis of Composting as an Environmental Remediation Technology*. U.S. Environmental Protection Agency, Solid Waste and Emergency Response (5305W), EPA530-R-98-008, April 1998.

W&H Pacific. 1993. *Demonstration Project Using Yard Debris Compost for Erosion Control, Final Report,* presented to Metropolitan Service District, Portland, Oregon.

Compost Filter Socks

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Sediment Control

Description

A compost filter sock is a type of contained compost filter berm. It is a mesh tube filled with composted material that is placed perpendicular to sheet-flow runoff to control erosion and retain sediment in disturbed areas. The compost filter sock, which is oval to round in cross section, provides a three-dimensional filter that retains sediment and other pollutants (e.g., suspended solids, nutrients, and motor oil) while allowing the cleaned water to flow through (Tyler and Faucette, 2005). The filter sock can be used in place of a traditional sediment and erosion control tool such as a silt fence or straw bale barrier. Composts used in filter socks are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids, and manure.


Installation of filter socks in a road ditch by Earth Corps for Indiana Department of Transportation. The filter socks will be staked through the center. Source: Filtrexx International, LLC.

Compost filter socks are generally placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. Filter socks are flexible and can be filled in place or filled and moved into position, making them especially useful on steep or rocky slopes where installation of other erosion control tools is not feasible. There is greater surface area contact with soil than typical sediment control devices, thereby reducing the potential for runoff to create rills under the device and/or create channels carrying unfiltered sediment.

Additionally, they can be laid adjacent to each other, perpendicular to stormwater flow, to reduce flow velocity and soil erosion. Filter socks can also be used on pavement as inlet protection for storm drains and to slow water flow in small ditches. Filter socks used for erosion control are usually 12 inches in diameter, although 8 inch, 18 inch, and 24 inch– diameter socks are used in some applications. The smaller, 8 inch–diameter filter socks are commonly used as stormwater inlet protection.

Compost filter socks can be vegetated or unvegetated. Vegetated filter socks can be left in place to provide long-term filtration of stormwater as a post-construction best management practice (BMP). The vegetation grows into the slope, further anchoring the filter sock. Unvegetated filter socks are often cut open when the project is completed, and the compost is spread around the site as soil amendment or mulch. The mesh sock is then disposed of unless it is biodegradable. Three advantages the filter sock has over traditional sediment control tools, such as a silt fence, are:

- Installation does not require disturbing the soil surface, which reduces erosion

- It is easily removed
- The operator must dispose of only a relatively small volume of material (the mesh)
- These advantages lead to cost savings, either through reduced labor or disposal costs. The use of compost in this BMP provides additional benefits, include the following:
    - The compost retains a large volume of water, which helps prevent or reduce rill erosion and aids in establishing vegetation on the filter sock.
    - The mix of particle sizes in the compost filter material retains as much or more sediment than traditional perimeter controls, such as silt fences or hay bale barriers, while allowing a larger volume of clear water to pass through. Silt fences often become clogged with sediment and form a dam that retains stormwater, rather than letting the filtered stormwater pass through.
    - In addition to retaining sediment, compost can retain pollutants such as heavy metals, nitrogen, phosphorus, oil and grease, fuels, herbicides, pesticides, and other potentially hazardous substances—improving the downstream water quality (USEPA, 1998).
    - Nutrients and hydrocarbons adsorbed and/or trapped by the compost filter can be naturally cycled and decomposed through bioremediation by microorganisms commonly found in the compost matrix (USEPA, 1998).

Applicability

Compost filter socks are applicable to construction sites or other disturbed areas where stormwater runoff occurs as sheet flow. Common industry practice for compost filter devices is that drainage areas do not exceed 0.25 acre per 100 feet of device length and flow does not exceed one cubic foot per second (see Siting and Design Considerations). Compost filter socks can be used on steeper slopes with faster flows if they are spaced more closely, stacked beside and/or on top of each other, made in larger diameters, or used in combination with other stormwater BMPs such as compost blankets.

Siting and Design Considerations

Compost Quality: Compost quality is an important consideration when designing a compost filter sock. Use of sanitized, mature compost will ensure that the compost filter sock performs as designed and has no identifiable feedstock constituents or offensive odors. The compost used in filter socks should meet all local, state, and Federal quality requirements. Biosolids compost must meet the Standards for Class A biosolids outlined in 40 Code of Federal Regulations (CFR) Part 503. The U.S. Composting Council (USCC) certifies compost products under its Seal of Testing Assurance (STA) Program. Compost producers whose products have been certified through the STA Program provide customers with a standard product label that allows comparison between compost products. The current STA Program requirements and testing methods are posted on the USCC EXIT Disclaimer website.

The nutrient and metal content of some composts are higher than some topsoils. This, however, does not necessarily translate into higher metals and nutrient concentrations or loads in stormwater runoff. A recent study by Glanville, et al. (2003) compared the stormwater runoff water quality from compost- and topsoil-treated plots. They found that although the composts used in the study contained statistically higher metal and nutrient concentrations than the topsoils used, the total masses of nutrients and metals in the runoff from the compost-treated plots were significantly less than plots treated with topsoil. Likewise, Faucette et al. (2005) found that nitrogen and phosphorus loads from hydroseed and silt fence treated plots were significantly greater than plots treated with compost blankets and filter berms. In areas where the receiving waters contain high nutrient levels, the site operator should choose a mature, stable compost that is compatible with the nutrient and pH requirements of the selected vegetation. This will ensure that the nutrients in the composted material are in organic form and are therefore less soluble and less likely to migrate into receiving waters.

The American Association of State Highway Transportation Officers (AASHTO) and many individual State Departments of Transportation (DOTs) have issued quality and particle size specifications for the compost to be used in filter berms (USCC, 2001; AASHTO, 2003). The compost specifications for vegetated filter berms developed for AASHTO Specification MP 9-03 (Alexander, 2003) are also applicable to vegetated compost filter socks (personal communication, B. Faucette, R. Tyler, and N. Goldstein, 2005). These specifications are provided as an example in Table 1. Installations of unvegetated compost filter socks, however, have shown that they require a coarser compost than unvegetated filter berms. The Minnesota DOT erosion control compost specifications for “compost logs” recommend 30 to 40 percent weed-free compost and 60 to 70 percent partially decomposed wood chips. They recommend that 100 percent of the compost passes the 2-inch (51 mm) sieve and 30 percent passes the 3/8-inch (10 mm) sieve. Research on these parameters continues to evolve; therefore, the unvegetated filter sock parameters shown in Table 1 are a compilation of those that are currently in use by industry practitioners (personal communication, B. Faucette, R. Tyler, R. Alexander, and N. Goldstein, 2005). The DOT or Department of Environmental Quality (or similar designation) for the state where the filter sock will be installed should be contacted to obtain any applicable specifications or compost testing recommendations.

Design: Filter socks are round to oval in cross section; they are assembled by tying a knot in one end of the mesh sock, filling the sock with the composted material (usually using a pneumatic blower), then knotting the other end once the desired length is reached. A filter sock the length of the slope is normally used to ensure that stormwater does not break through at the intersection of socks placed end-to-end. In cases where this is not possible, the socks are placed end-to-end along a slope and the ends are interlocked. The diameter of the filter sock used will vary depending upon the steepness and length of the slope; example slopes and slope lengths used with different diameter filter socks are presented in Table 2.

Siting: Although compost filter socks are usually placed along a contour perpendicular to sheet flow, in areas of concentrated flow they are sometimes placed in an inverted V going up the slope, to reduce the velocity of water running down the slope. The project engineer may also consider placing compost filter socks at the top and base of the slope or placing a series of filter socks every 15 to 25 feet along the vertical profile of the slope. These slope interruption devices slow down sheet flow on a slope or in a watershed. Larger diameter filter socks are recommended for areas prone to high rainfall or sites with severe grades or long slopes. Coarser compost products are generally used in regions subject to high rainfall and runoff conditions.

Table 1. Example Compost Filter Parameters

Parameters [a,1,4]	Units of Measure[a]	Vegetated Filter Berm/Sock[a]	Unvegetated Filter Sock[b]
pH[2]	pH units	5.0 – 8.5	6 – 8
Soluble salt concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 5	Not applicable
Moisture content	%, wet weight basis	30 – 60	30 – 60
Organic matter content	%, dry weight basis	25 – 65	25 – 65
Particle size	% passing a selected mesh size, dry weight basis	- 3 in. (75 mm), 100% passing - 1 in. (25 mm), 90 – 100% passing - 0.75 in. (19 mm), 70 –	- 2 in. (51 mm), 100% passing - 0.375 in. (10 mm), 10% – 30% passing

		100% passing - 0.25 in. (6.4 mm), 30 – 75% passing Maximum particle size length of 6 in. (152 mm) Avoid compost with less than 30% fine particle (1 mm) to achieve optimum reduction of total suspended solids No more than 60% passing 0.25 in. (6.4 mm) in high rainfall/flow rate situations	
Stability[3] Carbon dioxide evolution rate	mg CO_2-C per gram of organic matter per day	<8	(same as vegetated)
Physical contaminants (manmade inerts)	%, dry weight basis	<1	<1

Sources: [a]Alexander, 2003; [b]Personal communication, B. Faucette, R. Tyler, N. Goldstein, R. Alexander, 2005

Notes:
[1] Recommended test methodologies are provided in [Test Methods for the Evaluation of Composting and Compost EXIT Disclaimer].
[2] Each plant species requires a specific pH range and has a salinity tolerance rating.
[3] Stability/maturity rating is an area of compost science that is still evolving, and other test methods should be considered. Compost quality decisions should be based on more than one stability/maturity test.
[4] Landscape architects and project engineers may modify the above compost specification ranges based on specific field conditions and plant requirements.

Table 2. Example Compost Filter Sock Slopes, Slope Lengths, and Sock Diameters

Slope	Slope Length (feet)	Sock Diameter (inches)
<50:1	250	12
50:1–10:1	125	12
10:1–5:1	100	12
3:1–2:1	50	18
>2:1	25	18

Source: Oregon Department of Environmental Quality (ODEQ), 2004

Installation: No trenching is required; therefore, soil is not disturbed upon installation. Once the filter sock is filled and put in place, it should be anchored to the slope. The preferred anchoring method is to drive stakes through the center of the sock at regular intervals; alternatively, stakes can be placed on the downstream side of the sock. The ends of the filter sock should be directed upslope, to prevent stormwater from running around the end of the sock. The filter sock may be vegetated by incorporating seed into the compost prior to placement in the filter sock. Since compost filter socks do not have to be trenched into the ground, they can be installed on frozen ground or even cement.

Limitations

Compost filter socks offer a large degree of flexibility for various applications. To ensure optimum performance, h eavy vegetation should be cut down or removed, and extremely uneven surfaces should be leveled to ensure that the compost filter sock uniformly contacts the ground surface. Filter socks can be installed perpendicular to flow in areas where a large volume of stormwater runoff is likely, but should not be installed perpendicular to flow in perennial waterways and large streams.

Maintenance Considerations

Compost filter socks should be inspected regularly, as well as after each rainfall event, to ensure that they are intact and the area behind the sock is not filled with sediment. If there is excessive ponding behind the filter sock or accumulated sediments reach the top of the sock, an additional sock should be added on top or in front of the existing filter sock in these areas, without disturbing the soil or accumulated sediment. If the filter sock was overtopped during a storm event, the operator should consider installing an additional filter sock on top of the original, placing an additional filter sock further up the slope, or using an additional BMP, such as a compost blanket in conjunction with the sock(s).

Effectiveness

A large number of qualitative studies have reported the effectiveness of compost filter socks in removing settleable solids and total suspended solids from stormwater (McCoy, 2005; Tyler and Faucette, 2005). These studies have consistently shown that compost filter socks are at least as effective as traditional erosion and sediment control BMPs and often are more effective. Compost filter socks are often used in conjunction with compost blankets to form a stormwater management system. Together, these two BMPs retain a very high volume of stormwater, sediment, and other pollutants.

The compost in the filter sock can also improve water quality by absorbing various organic and inorganic contaminants from stormwater, including motor oil. Tyler and Faucette (2005) conducted a laboratory test using 13 types of compost in filter socks. They found that half of the compost filter socks removed 100 percent of the motor oil introduced into the simulated stormwater (at concentrations of 1,000 – 10,000 milligrams per liter [mg/L]) and the remaining compost filter socks removed over 85 percent of the motor oil from the stormwater.

Cost Considerations

The Texas Commission on Environmental Quality reports that the cost of a 12-inch diameter compost filter sock ranges from $1.40 to $1.75 per linear foot when used as a perimeter control (McCoy, 2005). The costs for an 18-inch diameter sock used as a check dam range from $2.75 to $4.75 per linear foot (McCoy, 2005). These costs do not include the cost of removing the compost filter sock and disposing of the mesh once construction activities are completed; however, filter socks are often left on site to provide slope stability and post-construction stormwater control. The cost to install a compost filter sock will vary, depending upon the availability of the required quality and quantity of compost and the availability of an experienced installer.

References

Alexander, R. 2003. *Standard Specifications for Compost for Erosion/Sediment Control*, developed for the Recycled Materials Resource Center, University of New Hampshire, Durham, New Hampshire. Available at [www.alexassoc.net EXIT Disclaimer].

Alexander, R. 2001. *Compost Use on State Highway Applications,* Composting Council Research and Education Fund and U.S. Composting Council, Harrisburg, Pennsylvania.

AASHTO. 2003 *Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Designation MP-9, Compost for Erosion/Sediment Control (Filter Berms), Provisional,* American Association of State Highway Officials, Washington, D.C.

Faucette, et al. 2005. *Evaluation of Stormwater from Compost and Conventional Erosion Control Practices in Construction Activities,* Journal of Soil and Water Conservation, 60:6, 288-297.

Glanville et al. 2003. *Impacts of Compost Blankets on Erosion Control, Revegetation, and Water Quality at Highway Construction Sites in Iowa*, T. Glanville, T. Richard, and R. Persyn, Agricultural and Biosystems Engineering Department, Iowa State University of Science and Technology, Ames, Iowa.

Juries, D. 2004. *Environmental Protection and Enhancement with Compost,* Oregon Department of Environmental Quality, Northwest Region.

McCoy, S. 2005. Filter Sock Presentation provided at *Erosion, Sediment Control and Stormwater Management with Compost BMPs Workshop*, U.S. Composting Council 13th Annual Conference and Trade Show, January 2005, San Antonio, Texas.

MnDOT. 2005. *Storm Drain Inlet Protection Provisions, S-5.5 Materials, B. Compost Log,* Minnesota Department of Transportation, Engineering Services Division, Technical Memorandum No. 05-05-ENV-03, January 18, 2005.

ODEQ. 2004. *Best Management Practices for Stormwater Discharges Associated with Construction Activity, Guidance for Eliminating or Reducing Pollutants in Stormwater Discharges,* Oregon Department of Environmental Quality, Northwest Region.

Personal communications, 2005. Industry representatives were interviewed regarding the particle size and composition of composts currently used in vegetated and unvegetated filter socks. These representatives included Britt Faucette and Rod Tyler of Filtrexx, International, LLC; Nora Goldstein of BioCycle, Journal of Composting & Organics Recycling; and Ron Alexander of R. Alexander Associates, Inc.

Tyler, R. and B. Faucette. 2005. *Organic BMPs used for Stormwater Management—Filter Media Test Results from Private Certification Program Yield Predictable Performance,* U.S. Composting Council 13 th Annual Conference and Trade Show, January 2005, San Antonio, Texas.

USCC. 2001. *Compost Use on State Highway Applications*, U.S. Composting Council, Washington, D.C.

USEPA. 1998. *An Analysis of Composting as an Environmental Remediation Technology*. U.S. Environmental Protection Agency, Solid Waste and Emergency Response (5305W), EPA530-R-98-008, April 1998.

W&H Pacific. 1993. *Demonstration Project Using Yard Debris Compost for Erosion Control, Final Report,* presented to Metropolitan Service District, Portland, Oregon.