

Using compost biofilters for stormwater runoff treatment

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Soil loss rates from construction sites can be 10 to 20 times that of agricultural lands (USEPA, 2000). For example, forest lands lose an average of 0.36 tonne ha⁻¹ per year; agriculture loses an average of 5.5 tonne ha⁻¹ per year while construction sites average 73.3 tonne ha⁻¹ per year (GA SWCC, 2002).

Runoff from construction sites often contains high concentrations of fine sediments that enter into nearby bodies of water. These sediment-laden runoff volumes can lead to adverse impacts on aquatic habitat and water quality. Sediment runoff originating from construction sites is a widely recognized problem which has conventionally been controlled using a variety of erosion and sediment control measures. Although these measures reduce the amount of sediment from entering the waterways, they generally do not meet the required guidelines and standards (US EPA, 2000; MOEE, 2004).

Background

The use of compost for erosion control is not a new idea and there have been several studies conducted to determine the effectiveness of these control measures (e.g. Faucette *et al.*, 2006). There are currently three common methods for erosion control from construction sites, including: silt fences, hydro seeding and establishing vegetation.

A silt fence is a sediment trapping practice utilizing a geotextile fence, topography and vegetation and has been used for erosion control on slopes and around the edges of construction sites



Fig. 1: Flume for flow rate testing.

for years (Tyler, 2001). Although these applications have been utilized frequently enough in the past that many regional regulations have incorporated them as a requirement, they often do not provide ample environmental protection. In many cases the runoff passing through silt fences exceeds the water quality standards for allowable concentrations of suspended sediments.

Compost has been used in highway projects in order to control and treat stormwater runoff. Composted organics have been used effectively because of the high infiltration rate and the capacity to remove suspended sediments and sediment-bound contaminants in runoff from construction sites (Glanville, 2004).

A sustainable, green technology has been developed that uses large volumes of compost material as engineered biofilters. Compost is filled in mesh tubes also known as "socks" (in various diameters, 8" to 24") that are filled with compost. Compost from Canadian landfills has not yet been tested for its effectiveness in stormwater runoff treatment since using compost as a biofilter for removal of suspended sediments and sediment-bound contaminants is a relatively new idea.

In addition to assisting in sediment runoff control, these biofilters can also provide benefits to the agricultural sector by additionally recycling most of the raw organic wastes left after harvesting. Organic wastes found on farms do not breakdown fast enough to offer crops the required nutrients during their relatively short growing seasons in Canada. This new application for compost will be of significant environmental and economic benefit to the society.

Objectives

Test results are practically non-existent for compost from Canadian producers as a biofilter for stormwater runoff treatment. The long-term objectives of this research project, include: (1) to determine flow-through properties of the biofilter and to develop relationships for hydraulic design of the biofilter; (2) to determine the effectiveness of the biofilter in removal of contaminants from stormwater runoff; (3) to determine the longevity of the biofilters; (4) to develop design guidelines to

incorporate biofilters into best management practices for various site-specific applications; and (5) to develop a user-friendly design tool to facilitate the application of this new technology.

Methodology

Laboratory and field experiments were conducted to evaluate the effectiveness of the biofilters in removing contaminants from stormwater runoff. First, the three certified compost materials were tested to quantify the differences between the products. Each compost sample was tested for particle size distribution, bulk density, and void ratio (USCC, 2004). Next, a set of flow-through runs were conducted in a controlled laboratory setting (Fig. 1) and a numerical model was developed for hydraulic design of the system.

The first cycle of field experiments was completed in the summer of 2006 at the Guelph Turf Grass Institute, University of Guelph, to evaluate sediment removal efficiency of the biofilters. A set of controlled field tests were conducted to determine the effect of compost material, mesh tube (sock) diameter size and number of socks on sediment removal efficiency and longevity of the biofilters (Fig. 2).

The field tests performed to date have focused on suspended sediment removal efficiency. Laboratory analyses of the runoff samples consisted of suspended sediment removal and particle size distribution comparisons of inflow versus outflow. The experiments designed to test for phosphorus, metals and petroleum hydrocarbons will commence in April of 2007.

Results

The following preliminary results are based on the laboratory and field experiments conducted during the first cycle of experiments in summer 2006. The maximum flow-through rate without overtopping per unit width of the 8" new sock for the three compost materials (overs) tested was approximately 1.5 L/s. The flow-through capacity of the 12", 18" and the 24" socks were approximately 50%, 200%, and 300% higher than the flow-through capacity of the 8" sock. As the sediments started to accumulate in the biofilter over time, the flow-through rate decreased. Further testing will be completed to



Fig. 2: Example of field experiment setup for three sets of socks, with five socks in each set.

quantify this effect.

The average sediment removal efficiency of the 8" socks for 5, 10, and 15 rolls was between (20% to 40%), (40% to 60%), and (60% to 80%), respectively. Larger diameter socks provided larger filter media and were more effective than the smaller diameter socks. The 18" sock was approximately twice as effective as the 8" mesh tube. The sediment removal efficiency of 5 rolls of the 18" sock dropped from 55% to 39% after 30 consecutive runs and, similarly, the efficiency of 5 rolls of the 8" sock dropped from 40% to 18% after 17 consecutive runs.

Conclusion

This study indicates that compost biofilters are effective measures for controlling sediments in stormwater runoff for construction sites. With

proper design, compost biofilters can filter out sediments and sediment-bound contaminants for large volumes of stormwater runoff. Hence, this technology demonstrates the application of compost for construction sites and highway runoff, and improves the sustainability of compost operations by identifying an effective and valuable

use for the compost.

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