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TechLink Research Summary #3340

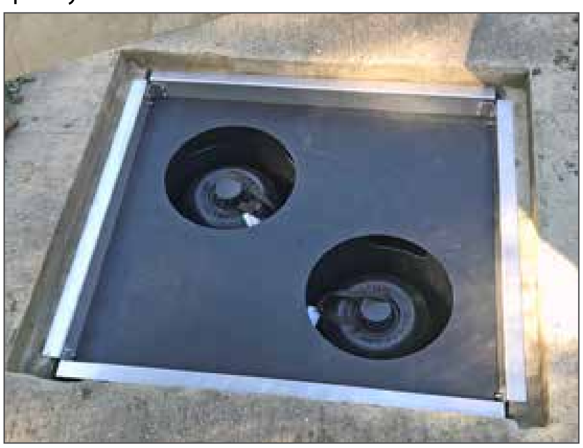
StormExx® Technology Performance Evaluation Under Large Scale Test Conditions

INTRODUCTION

According to the U.S. Environmental Protection Agency's (US EPA) national water quality assessment, 35% of U.S. streams are severely impaired and 75% of the population lives within 10 miles of an impaired surface water (US EPA, 2007). In accordance with Section 303(d) of the Clean Water Act, the US EPA designates specific stream segments as impaired, triggering Total Maximum Daily Load (TMDL) development for particular pollutants in contributing watersheds - today there are approximately 50,000.

Storm water runoff is one of the leading sources of these pollutants. Typical concentrations in urban post-construction storm water runoff contributing to water quality impairment for total suspended solids (TSS) range from 50 mg/L to 1000 mg/L, phosphorus (P) from 0.24 mg/L to 3.6 mg/L and heavy metals from 0.0001 mg/L to 5 mg/L (Flint and Davis 2007).

Pollutants in urban storm water typically originate from non-point sources, and the majority of these pollutants are typically in soluble form. Berg and Carter (1980) reported that soluble pollutants may exceed 80% of the total storm water pollutant load where land surfaces have been stabilized. In many watersheds, soluble pollutants may be of greater concern due to an increased bioavailability to aquatic organisms, relative to sediment-bound pollutants. Storm water permit holders need adequate technology and best management practice (BMP) information to effectively reduce site storm water pollutants, protect the quality of receiving waters, and comply with industrial and municipal storm water permit effluent limit guidelines for storm water quality.



The US EPA National Pollutant Discharge Elimination System (NPDES) Phase II National Menu of Best Management Practices (BMPs) includes compost filter socks as a leading means to manage runoff (US EPA 2006), while USDA ARS and university research shows these compost-based biofilters can target and filter a variety of storm water pollutants (Faucette et al., 2005; Faucette and Tyler, 2006; Faucette et al., 2006; Keener et al., 2007; Faucette, et al., 2008; Faucette et al., 2013). StormExx is the latest technology to use compost biofiltration in a storm water application. StormExx is a below grate drop inlet filtration system that utilizes a biofiltration cartridge to target specific pollutants commonly found in urban, municipal, and industrial storm water runoff.

The objective of this study was to evaluate the pollutant removal performance for TSS, phosphorus, copper (Cu), and zinc (Zn) of StormExx under large-scale test conditions.

MATERIALS AND METHODS

Experimental Design, Test Set-Up, Water Analysis

Research was conducted at SWM laboratory, 2810 Weeks Ave SE, Minneapolis MN 55414. The laboratory study was designed to simulate and evaluate the storm water runoff pollutant removal performance of StormExx. Experiments were conducted to test the removal efficiency of the system for various pollutants from synthetic runoff. Pollutants evaluated included total suspended solids (TSS), phosphorus (P), copper (Cu), and zinc (Zn).

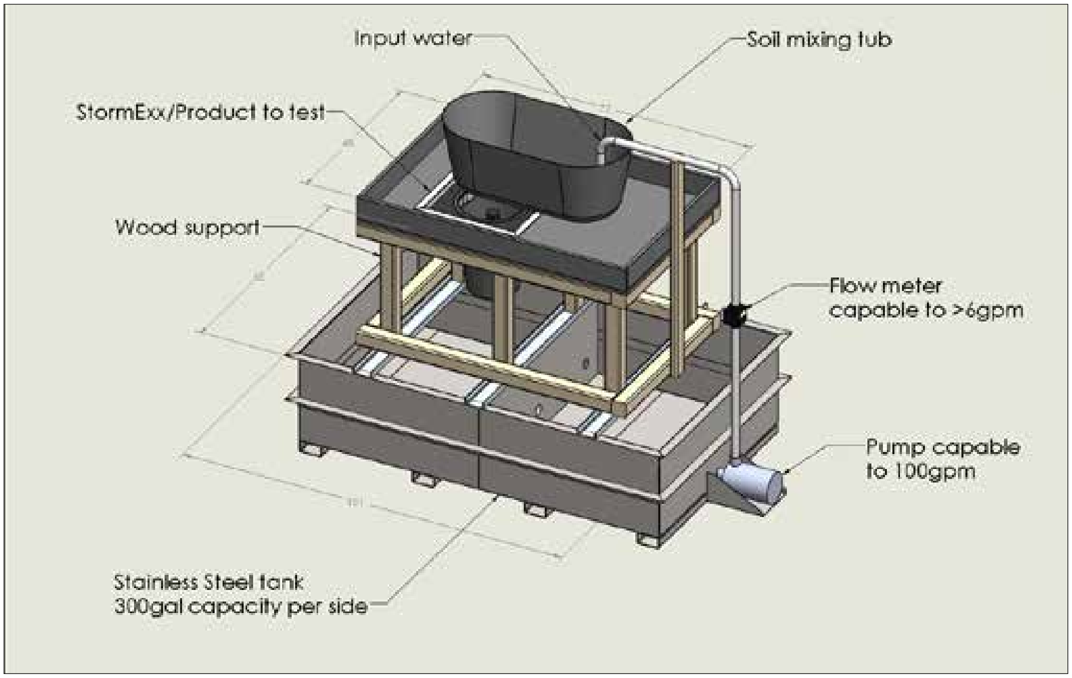
Each experiment evaluated a single pollutant, based on concentrations typical to urban, industrial, and municipal storm water runoff under a 20 minute duration to simulate first flush storm water design conditions. The experiment used a full-scale experimental design with a design flow rate of 4 gal/min. See Figure 1 for experimental test design set-up.

Synthetic runoff for the influent was generated by adding soluble form pollutants to municipal tap water into a stainless steel reservoir at the base of the test system, mixed, and pumped to an upper reservoir. Sediment for TSS was mixed with municipal tap water in the upper reservoir, agitated to suspend sediments, and all pollutants gravity flowed into the treatment system. Concentrated soluble pollutants were obtained from ERA Laboratory Supply Company (Golden, CO), sediment for TSS used an AASHTO sandy loam soil. Particle size distribution for the soil used for sediment was 10% < 0.002 mm, 7.5% < 0.06 mm, and

82.6% < 2.0 mm. Effluent samples were collected using discrete, interval grab samples every 5 minutes until the end of the event period. All collected influent and effluent water samples followed chain of custody protocols and were preserved in a cooler immediately after sampling and until delivery to the analytical laboratory. All storm water pollutants used US EPA sampling and analytical test methods described in the Methods for Chemical Analysis of Water and Wastes (US EPA, 1983) performed by Legend Analytical Laboratories.

Event removal efficiency (%) was determined for each pollutant and each event by dividing the total effluent average concentration by the influent concentration. The total effluent average concentration was determined by averaging each time interval over the entire storm event.

Figure 1. Large-scale experimental design set-up.



RESULTS

Table 1. Pollutant concentrations (mg/L) for influent; effluent at 5 min, 10 min, 15 min, and 20 min intervals; total event average; and total event removal efficiency (%).

Pollutant	TSS	P	Cu	Zn
Influent	231	0.66	0.08	2.2
5 min	158	0.14	0.037	1.7
10 min	114	0.085	0.035	1.2
15 min	119	0.084	0.036	1.2
20 min	109	0.036	0.037	1.1
Average	125	0.09	0.037	1.3
Removal Efficiency	**46**	**87**	**52**	**40**

SUMMARY AND CONCLUSION

Based on this evaluation, the StormExx biofiltration storm water treatment system has the ability to target and remove TSS, nutrients, and heavy metals. These results give science-based evidence that this technology can be an effective best management practice and treatment system used in a comprehensive treatment train design approach to meet municipal and industrial storm water permit requirements.

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