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THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

NSF International

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**CATCH BASIN INSERT**
APPLICATION:	**IN-DRAIN TREAMENT TECHNOLOGY**
TECHNOLOGY NAME:	**HYDRO-KLEEN™ FILTRATION SYSTEM**
TEST LOCATION:	**ANN ARBOR, MICHIGAN**
COMPANY:	**HYDRO COMPLIANCE MANAGEMENT, INC.**
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NSF International (NSF) manages the Water Quality Protection Center (WQPC) under the U.S. Environmental Protection Agency's (EPA) Environmental Technology Verification (ETV) Program. NSF evaluated the performance of the Hydro Compliance Management, Inc. Hydro-Kleen™ Storm Water Filtration System, a catch basin insert designed to mitigate hydrocarbon, suspended solids, and metals concerns from storm water and human-generated surface runoff. Testing was completed at the NSF laboratory in Ann Arbor, Michigan.

EPA created the ETV Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV program is to further environmental protection by accelerating the acceptance and use of improved and more cost-effective technologies. ETV seeks to achieve this goal by providing high quality, peer reviewed data on technology performance to those involved in the design, distribution, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations; stakeholder groups consisting of buyers, vendor organizations, and permitters; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated, and that the results are defensible.

TECHNOLOGY DESCRIPTION

The following technology description is provided by the vendor and does not represent verified information.

The Hydro-Kleen™ Filtration System is a patented, multi-media filtration system with sedimentation containment and overflow bypass protection. The systems are designed to fit within existing catch basins in locations such as parking lots, truck bays, and other paved areas. They are also sometimes placed downstream from "hot spots" such as gas stations, parking lots, and other industrial/commercial sites with higher contaminant loadings. Each system is custom manufactured, for retrofit or specification, to fit specific catch basins or drain sumps. The tested system was designed to fit within an East Jordan Iron Works Model 5105 catch basin frame.

The Hydro-Kleen™ system consists of a stainless steel rim attached to a molded polyethylene housing, which is separated into two chambers. Water enters a sedimentation chamber, where heavy suspended solids and debris passing through the grate are collected, then passes through transition outlets along the top of the sedimentation chamber into the filtration chamber. The primary media in the filtration chamber is designed to remove hydrocarbons by adsorption to a hydrophobic cellulose material (Sorb-44). The secondary media in the chamber is a blend of activated carbon (AC-10) designed to remove most remaining hydrocarbons and a variety of other contaminants from the water. Treated water then passes through the bottom of the filtration chamber into the catch basin. In situations where the flow to the system exceeds the capacity of the filtration chamber (up to an equivalent of one-half inch of rain per hour), water is diverted through bypass outlets, preventing flooding or ponding at the catch basin. A complete description of the system is provided in the verification report.

VERIFICATION TESTING DESCRIPTION

Methods and Procedures

The testing methods and procedures employed during the study were outlined in the Verification Test Plan for Hydro Compliance Management, Inc. Hydro-Kleen™ Filtration System. The Hydro-Kleen™ system was placed in a specially designed testing rig to simulate a catch basin receiving surface runoff. The rig was designed to provide for controlled dosing and sampling, and to allow for observation of system performance.

The Hydro-Kleen™ system was challenged by a variety of hydraulic flow and contaminant load conditions to evaluate the system's performance under normal and elevated loadings. Two additional tests were conducted at the vendor's request to determine the media's hydrocarbon capacity at continuous flow, and to evaluate system performance at reduced suspended solids loading.

A synthesized wastewater mixture containing petroleum hydrocarbons (gasoline, diesel fuel, motor oil, and brake fluid), automotive fluids (antifreeze and windshield washer solvent), surfactants, and sediments (sand, topsoil and clay), was used to simulate constituents found in surface runoff from a commercial or industrial setting. Influent and effluent samples were collected and analyzed for several parameters, including total petroleum hydrocarbons (TPH), oil & grease (O&G), and total suspended solids (TSS). Complete descriptions of the testing and quality assurance/quality control (QA/QC) procedures are included in the verification report.

PERFORMANCE VERIFICATION

System Installation and Maintenance

The Hydro-Kleen™ system was found to be durable and easy to install, requiring no special tools. The vendor made several modifications to the system housing during installation, including changes to the rim and openings in the chambers of the housing. The modifications are described in the verification report, and the vendor has indicated they will be included in new systems.

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Maintenance on the system during testing consisted of cleaning or replacing the filter media bags, and removing sediment and water collected in the sediment chamber. Maintenance took approximately 15 minutes, with the most difficult activity being removal of the storm grate cover. The filter media bags were observed to be slightly different in size and weight from bag to bag, but there was no indication that this impacted the performance of the system.

Hydraulic Capacity

The hydraulic capacity of the Hydro-Kleen™ system was determined using clean water, synthetic wastewater, and synthetic wastewater with spiked constituents. The capacity was identified as the greatest flow rate achieved before wastewater exited the system through the bypass holes. The testing determined the maximum treated effluent flow rates to be approximately 30 gallons per minute (gpm) with clean water, 22 gpm with synthetic wastewater, and 12 gpm with synthetic wastewater containing elevated (four times normal) constituent concentrations.

The influent flow rate was increased to the maximum flow attainable by the test rig (135 gpm) to determine if the Hydro-Kleen™ system would cause the catch basin to surcharge and flood the surface above the grate. The Hydro-Kleen™ system's bypass holes, which are designed to exceed the maximum hydraulic capacity of the catch basin grate, allowed the entire flow to pass with no surface flooding.

Suspended Solids Removal

Suspended solids removal efficiency for the system was measured three ways: (1) analytically, by comparing TSS concentrations sampled from the influent and treated effluent; (2) theoretically, by comparing the calculated concentration of suspended solids in the influent (mass of suspended solids fed into water divided by influent water volume) with the analytical concentration of solids in effluent TSS samples; and (3) by a mass balance comparing the dry weight of suspended solids added to the influent with the dry weight of suspended solids removed from the system (the two chambers and the media) during cleaning. The different methods yielded results with a high degree of variability.

The mean influent TSS concentration was 400 mg/L. The analytical method showed a mean removal efficiency of 51 percent, with a range of minus 60 to 100 percent. The theoretical method showed a mean efficiency of 82 percent, with a range of 55 to 100 percent. These efficiency calculations do not take into account the wastewater that bypassed filtration through the filter holes. The mass balance method showed removal efficiency by the system between 46 and 75 percent.

Media Blinding/Bypass

During most tests, the system showed evidence of filter media blinding and bypass of untreated influent before reaching the filter media's hydrocarbon capacity. The manufacturer's operation and maintenance (O&M) manual includes a procedure, when media blinding is observed, of removing the filter media bags from the housing, shaking them, and placing them back into the filtration chamber. This procedure was tested and a temporary elimination of bypass flows was observed; however, the filter media blinded off quickly when loading was resumed. This observation is shown graphically in Figure 1.

Tests conducted with varying influent hydrocarbon and TSS concentrations showed that the rate of blinding was significantly impacted by the combination of TSS and hydrocarbons in the influent. An additional test was run in which TSS and hydrocarbons were added to the influent for a day, followed by a day of dosing where the hydrocarbons were removed from the influent. When hydrocarbons were not injected into the synthetic wastewater, the rate of media blinding decreased and stabilized. When hydrocarbons were reintroduced to the influent, media blinding resumed at the same rate as in the initial period. No media blinding was observed during a test in which the influent wastewater was injected with hydrocarbons, but no TSS.

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Filter media blinding can be related to the mass of hydrocarbon-impacted TSS entering the system. The testing demonstrated that every three pounds of hydrocarbon-impacted TSS treated by the system reduced the treated effluent flow rate by approximately 10 percent.

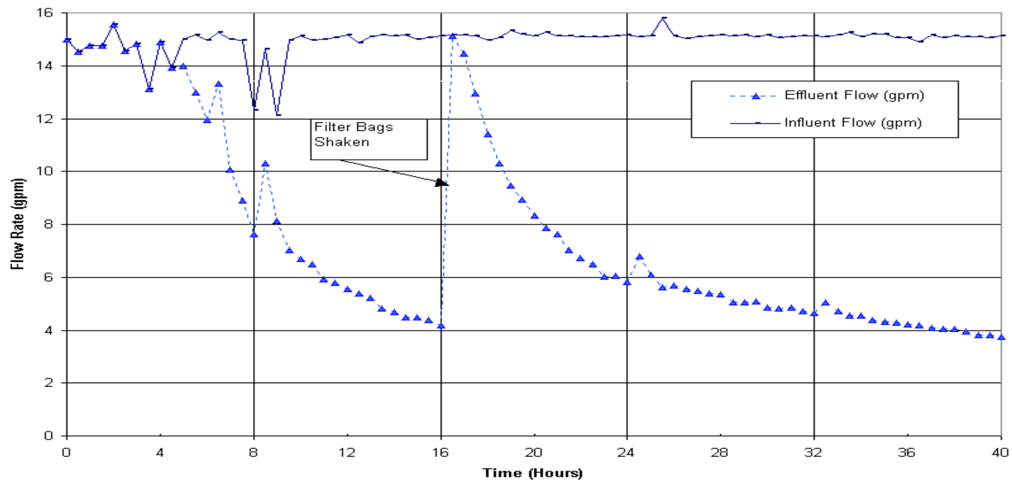

Figure 1. Influent versus effluent flows following filter media maintenance.

Hydrocarbon Removal

Hydrocarbon Reduction: Based on TPH and O&G analytical data, a comparison of influent and effluent samples collected during all test phases showed that a properly maintained Hydro-Kleen™ system was capable of reducing hydrocarbon concentrations in the treated effluent. The treatment efficiencies shown in Table 1 do not take into account the wastewater that bypassed filtration. The vendor recommends maintenance on the filter media bags whenever media blinding is observed; however, the test plan restricted maintenance events to evaluate the rate of media blinding. Details on media blinding rates are expressed further in the verification report.

Table 1. Treatment Efficiency Measured by TPH and O&G

	TPH			O&G		
Statistical measure	**Influent (mg/L)**	**Effluent (mg/L)**	**Percent reduction**	**Influent (mg/L)**	**Effluent (mg/L)**	**Percent reduction**
Average	48	13	77	62	13	78
Median	47	11	81	65	14	78
Maximum	88	22	95	126	19	97
Minimum	10	<10	32	7.8	5.5	29
Standard Deviation	24	3.8	0.2	31	4.6	0.2

Note: Statistical measures based on 17 sets of TPH samples and 15 sets of O&G samples.

Hydrocarbon Capacity: The hydrocarbon capacity test used a stock hydrocarbon solution (gasoline, diesel fuel, motor oil and brake fluid) having a density of 803 grams per liter (6.69 pounds/gallon). Approximately 28,800 L (7,600 gal) of water was fed to the test unit during the capacity test. The stock hydrocarbon solution was mixed into water to achieve a mean TPH concentration of 135 mg/L and a mean O&G concentration of 173 mg/L. The TPH removal efficiency at the start of the test was 82 percent, dropping to 30 percent at the end of the test. Based on the TPH data, the hydrocarbon capacity of the media was approximately 2,890 grams (6.36 pounds). The results for O&G followed a similar pattern,

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with an initial removal efficiency of 84 percent and an ending removal efficiency of 22 percent. Based on the O&G data, the hydrocarbon capacity of the media was approximately 2,930 grams (6.45 pounds).

Nutrient and Surfactant Treatment

The Hydro-Kleen™ system was ineffective at treating nutrients (e.g., nitrates, ammonia, total Kjeldahl nitrogen) and surfactants (methylene blue active substances [MBAS]) in the wastewater, which was consistent with the vendor's claims.

Metals Treatment

The vendor claims that the Hydro-Kleen™ system can treat organically bound metals, such as metals in used oil, but is ineffective at treating metals dissolved in an aqueous solution. The synthetic wastewater contained low concentrations of dissolved-phase metals, but no organically bound metals. Consistent with vendor claims, the testing showed the Hydro-Kleen™ system to be ineffective at removing metals.

Quality Assurance/Quality Control

During the testing, NSF personnel uninvolved with the test completed a technical systems audit to ensure that the testing was in compliance with the test plan. NSF also completed a data quality audit of at least 10 percent of the test data to ensure that the reported data represented the data generated during testing. In addition to QA/QC audits performed by NSF, EPA QA personnel conducted a quality systems audit of NSF's QA Management Program.

Original signed by *Lee A. Mulkey*	*10/23/03*		*Original signed by* *Gordon Bellen*	*10/30/03*
Lee A. Mulkey Acting Director National Risk Management Laboratory Office of Research and Development United States Environmental Protection Agency	Date		Gordon Bellen Vice President Research NSF International	Date

NOTICE: Verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. EPA and NSF make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of corporate names, trade names, or commercial products does not constitute endorsement or recommendation for use of specific products. This report is not an NSF Certification of the specific product mentioned herein.

Availability of Supporting Documents

Copies of the Protocol for the Verification of In-Drain Treatment Technologies, April 2001, the verification statement, and the verification report (NSF Report #03/07/WQPC-SWP) are available from the following sources:

ETV Water Quality Protection Center Program Manager (order hard copy)
NSF International
P.O. Box 130140
Ann Arbor, Michigan 48113-0140

NSF web site: http://www.nsf.org/etv (electronic copy)

EPA web site: http://www.epa.gov/etv (electronic copy)

(NOTE: Appendices are not included in the verification report, but are available from NSF upon request.)

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