FABCO INDUSTRIES, INC
BEACH / HARBOR STORM WATER
TEST PROGRAM

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Executive Summary

Under an agreement between a local municipality and Fabco Industries, a Long Island based manufacturing firm, during the summer of 2006 a series of tests were performed on the Fabco catch basin inserts to evaluate there effectiveness in reducing certain identified bacteria contained in the surface water runoff. The product testing took place over a 90 day period at a beach front parking lot with known high levels of bacterial contamination. The device being tested was Fabco's StormBasin product which was supplied with two filter cartridges configured for maximum bacteria reduction.

The testing protocol focused on collecting efficiency data under real storm conditions. Only minimal maintenance was performed during the 90 day period and the same filtering cartridges were used from start to finish in order to better represent actual conditions. Sampling was also varied so that effectiveness could be measured during first flush as well as well as during the storm event. The report data presented here confirms that the StormBasin product was highly effective in reducing 3 types of indicator bacteria: E.Coli (77%), Enterococcus (49%) and Fecal Coliform (77%) .

Although not reported as part of the test, the StormBasin also collected considerable trash and debris such as plastic bottles and caps, candy wrapper, cigarette butts, and other material that would have been directed into the harbor.

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Introduction:

Rainwater flowing over paved surfaces can accumulate a variety of pollutants that in many cases are then transported and deposited in a storm sewer system. The more common pollutants associated with this runoff water include: sediments from simple erosive actions; oils, grease and even heavy metals such as chrome, zinc and cadmium from motor vehicles; nutrients, pesticides and other chemicals from agricultural activities, and potentially pathogenic organisms including bacteria that are released into the environment from poor land use, flawed waste disposal practices and other sources. In many cases this contaminated water finds its way to local rivers, lakes and estuaries, which results in the degradation of water quality. In fact, the EPA identifies surface water runoff as the leading contributor to water pollution.

Under section 303d of the Federal Clean Water act, each state is required to generate a list of impaired water ways that do not meet the water quality standards for their intended use. Currently, the EPA lists over 38,000 impaired waters in the United States. The top 5 impairments are: Mercury, Pathogens, Sediments, heavy metals (other than mercury) and nutrients.

This study focuses on the Fabco Industries StormBasin filter and its effectiveness in treating bacteria in surface water runoff. For these trials, Fabco StormBasin filters were installed in catch basin drains located in the parking field of a small public beach. This particular coastal area was selected based on a history of high bacterial counts following rain events, which may have contributed to beach closings and a prohibition of shell fishing in the area.

Background:

The Fabco Industries StormBasin is a water-filtering system that installs below the iron grate of an existing storm water sewer. The StormBasin can be installed into most existing grated storm water drains without construction or other modifications. In this position the StormBasin intercepts and treats many of pollutants suspended and/or contained in surface water runoff including: sediments, trash and debris; oils, grease and other toxic hydrocarbon-based chemicals as well as potentially harmful bacteria

Related articles on bacteria, pathogens and the impact from storm water can be found on line at www.oasisdesign.net and at the Federal EPA website: http://www.epa.gov/beaches/

The Technology:

The Fabco StormBasin system consists of a large tub for the collection of raw water, sediments and debris and one or more filtering cartridges located at the bottom of the tub, which treat and discharge the clean water into the storm water system.

The StormBasin cartridges are selected based on actual pollutant loads and are user replaceable when required. Currently there are 4 different cartridge configurations to choose from: general purpose, hydrocarbons (oils & grease), bacteria and heavy metals. Each of the cartridge types applies one or more technologies in varying degrees to treat specific pollutants. For bacteria, the Fabco filter consists mainly of polymer foam treated with a proprietary antimicrobial technology.

The patented antimicrobial technology is applied as a liquid to the polymer foam material to form a colorless, odor-less, positively charged coating which chemically bonds, in a virtually irremovable manner, to the treated surface. At the microscopic level it resembles a layer of electrically charged stiff fibers or swords extending outward in all directions. When a microorganism comes in contact with the treated surface, the swords puncture the cell membrane and an electrical charge shocks the cell. Since nothing has been transferred to the now dead cell, the antimicrobial treatment doesn't lose strength and is ready for the next organism to contact it.

Site description:

The sewer drain selected for the study had a 24"x48" grate and featured a rear open box inset into the concrete curb. Depth of the vault below the grate was approximately 40".

The drain was located in the Northeast corner of the parking field and serviced approximately 5900 square feet of black top paving. The parking field was slightly sloped towards the drain causing considerable accumulations of sediments, trash and debris.

Fabco Industries installed a 22"x 44" StormBasin (p/n 9731- 1E) which was configured for the rear open curb box. This configuration features a formed rubber flap that extends from the back edge of the tub into the rear open box. This flap enhances the unit's ability to capture the very low flows that are generated typically during the first flush period of a storm. The StormBasin selected featured two (2) Bacteria filtering cartridges p/n 9718-2 (Yellow ring)

Objectives:

These field studies involved several major objectives. The most important of these was the evaluation of the effectiveness of the StormBasin filters to remove various bacteria contained in stormwater.

Secondly, as an integral part of the analysis of bacteria in stormwater, these studies were designed to provide valuable information with respect to the use of automatic/remote sampling systems Vs manual grab sampling. This aspect of the trials was of special interest in that very little comparative information was available concerning field sampling during storm events.

Thirdly, these trial runs were also focused on understanding the operational characteristics and effectiveness of the StormBasin when exposed to actual field conditions. Most importantly, while it was assumed that the unit would function in a first flush condition, based on static laboratory evidence, would it continue to be effective over an extended time and during continuous flow conditions that exist during a storm event.

A list of beaches listed under the National Beach Act can be found at http://www.epa.gov/waterscience/beaches/list/list-of-beaches.pdf. Information on Bacterial water quality standards can be found at: http://www.epa.gov/waterscience/beaches/local/statrept.pdf

Methods:

The sampling protocol called for the simultaneous collection of both an untreated and treated sample during a single rain event. The samples collected were evaluated by an independent laboratory[1] for reductions in the common indicator organisms: Fecal Coliform, E. coli and Enterococcus bacteria.

The monitoring would take place over an indefinite time period with little or no maintenance being performed on the unit during the monitoring period.

This report includes data accumulated during a 3-month period starting in August and ending in November of 2006. Samples were collected on 5 occasions. In total the site experienced 32 separate storm events where rain accumulations exceeded 0.01”

Total rain events and accumulations
(Observed daily data Long Island Mac Arthur AP)

Time period	No# of days with precip	Time period	No# of days with precip
Aug. 14 – 31 Total 5.58	8 >= .01 6 >= 0.1 4 >= 0.5 2 >= 1.0 1>= 2.0	Sept. 1 – 30 Total 4.29”	9 >= .01 7 >= 0.1 1 >= 0.5 1 >= 1.0 1>= 2.0”
Oct. 1 – 31 Total 7.09”	12 >= .01 8 >= 0.1 4 >= 0.5 2 >= 1.0 2 >= 2.0	Nov. 1 – 8 Total 1.9”	3 >= .01 3 > = 0.1 1 > = 0.5 1 > = 1.0

Monitoring duration: 87 days / 32 storm events with >= 0.01” of rain
Total rain fall >= 18.86” – See appendix D for monthly weather data

Sampling dates and collection methods

Sampling Date	Rain fall: 24 hrs	Collection method	Event
August 15	.09”	Auto New cartridge	1st flush
August 25	1.58”	Auto Cartridge installed Aug 15	1st flush
September 14 (2 sets)	.58”	Auto & Manual Cartridge installed Aug 15	1) First flush 2) During event
October 20	.34”	Manual Cartridge installed Aug 15	During event
Nov 8	1.67”	Manual Cartridge installed Aug 15	During event

A new StormBasin was installed on August 14th at the start of the monitoring process. Weather data confirmed there had been no rain events for the first 14 days of the month.

Water samples would be collected either automatically or manually using a battery powered, Global Water, Model SS201 Storm water sampler (appendix F) and two standard bacteria cartridges.

The Global unit features a large, watertight plastic case and dual individually controlled peristaltic sampling pumps with 2 sample bottles. For this test, the standard 1-gallon sampling bottles were replaced with smaller 1 liter bottles. Use of the smaller bottles allowed us to insert refrigerated “cool” packs inside the case to refrigerate the samples. With this method adequate cooling as prescribed by EPA testing protocols could be maintained for about 12 to 16 hours.

To collect the water samples leaving the StormBasin special collection “pails” or “buckets” were designed to attach and seal directly to the bottom of the standard Fabco Cartridge body. In the image below, the standard cartridge body is dark blue. The collection pail area is a light green color and is sealed to the cartridge body with white tape.

Collection pail features:

1) A vertical over-flow pipe – To maintain approximately 2 liters of water in the pail while allowing excess water to escape.
2) A quick connect coupling – Connects pail to the supply line of the peristaltic pump and sample bottle.
3) A sensor switch - Activates pumps when the minimum level of water has accumulated in the pail.

Two collection pails were fabricated. The first was attached to the standard Fabco filtering cartridge. The second was attached to an empty cartridge- no filtering media. These two filters were then installed into the bottom of the StormBasin unit with the supplies lines routed to the Global Sampler.

Sampling:

During a storm event surface water enters the StormBasin, flows into and through the cartridges and collects in the pails. In automatic operation when approximately, 2 liters of water has collected, the sensor switch activates the pumps and two **First Flush** water samples are collected. The cartridge with the media left in place would supply a sample of treated water. The empty cartridge would collect a sample of untreated raw water.

Operational note: Prior to automatic testing on August 25 and September 14th the sampling cartridges were removed from the StormBasin in order to drain and clean the collection pails. During removal of the cartridges, collected sediments and debris were left undisturbed.

Manual samples were taken on September 14th, October 20th and on November 8th. These samples were acquired during the rain event and represent a snap shot of the treatment process. Manual samples were taken by pushing the ON button for each pump long enough to fill a sampling bottle. These samples were taken somewhere between 1 and 6 hours from the start of the storm. The filtering cartridges were not removed / cleaned before the manual sampling procedure as any water collected in the pails previous to the storm event would have been displaced.

Results:

The daily results of the monitoring study are presented in the attached tables A, B & C. In summary:

Bacteria	Min reduction	Max Reduction	Average
Fecal Coliform	64%	92%	77%
E.coli	64%	85%	77%
Enterococcus	11%	81%	49%

[1] Sample analysis provided by: EcoTest Laboratories Inc, 377 Sheffield Ave, North Babylon, NY 11703 Tel: 631 422 5777 See Appendix E for individual daily reports

The StormBasin efficiency on Fecal Coliform and E.coli during the field study was somewhat expected based on previous dynamic cartridge studies performed for Fabco in local testing laboratories. These laboratory tests consistently showed a greater than 80% reduction in both bacteria types. However, these previous “bench studies” did not simulate real world conditions especially in terms of the actual water composition, suspended solids, flow rates and sampling difficulties. The results of these field studies, on the other hand, demonstrate that the cartridges are effective in the field and can continue to treat bacteria at high efficiency over time even with minimal maintenance.

This study also represents Fabco’s first testing on the Enterococcus bacteria. Compared to the results for E.coli and Fecal Coliform the cartridge does not seem as effective for

this bacteria strain. But it is important to recognize here that there were unexplained large fluctuations in the reported results for enterococci that had a significant impact on the final results. It's possible that the testing and/or sampling protocols need to be modified or reevaluated to better report on this type of bacteria. However we shouldn't lose sight that a 49% reduction of this bacteria combined with the nearly 80% reductions recorded for Fecal Coliform and E.coli does indicate good reductions in potentially pathogenic single cell bacteria overall.

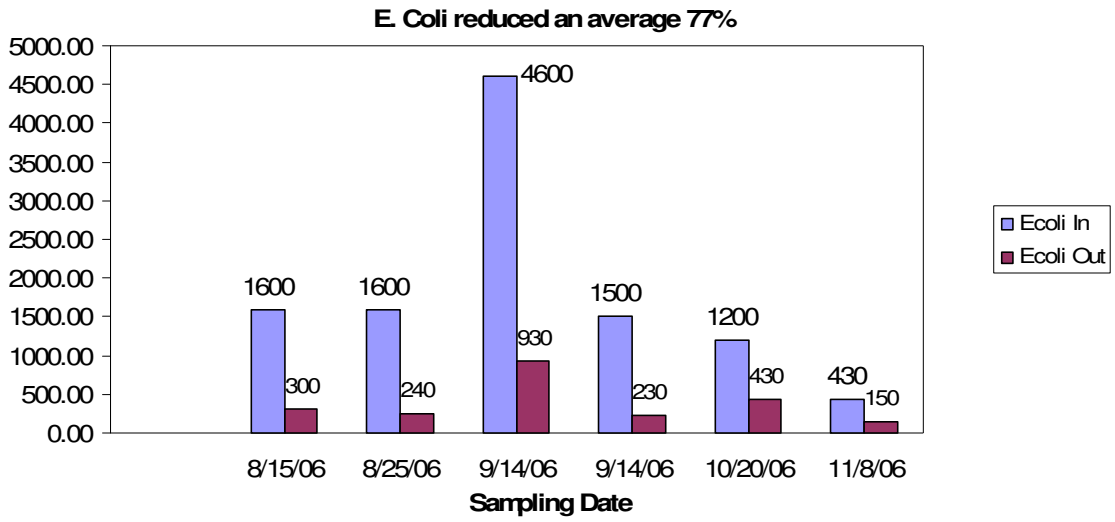
Conclusion:

In summary, it is apparent that the Fabco StormBasin can provide significant reductions in the bacteria normally associated with stormwater.

This is particularly significant in view of the fact that the unit operated at a uniform level of efficiency for 3 months during which 32 individual storm events deposited nearly 19 inches of rain on the paved surfaces surrounding this drain. Moreover, the attendant accumulation of over 15 pounds of sediment and debris in the StormBasin did not have any measurable impact on the operational efficiency of the unit.

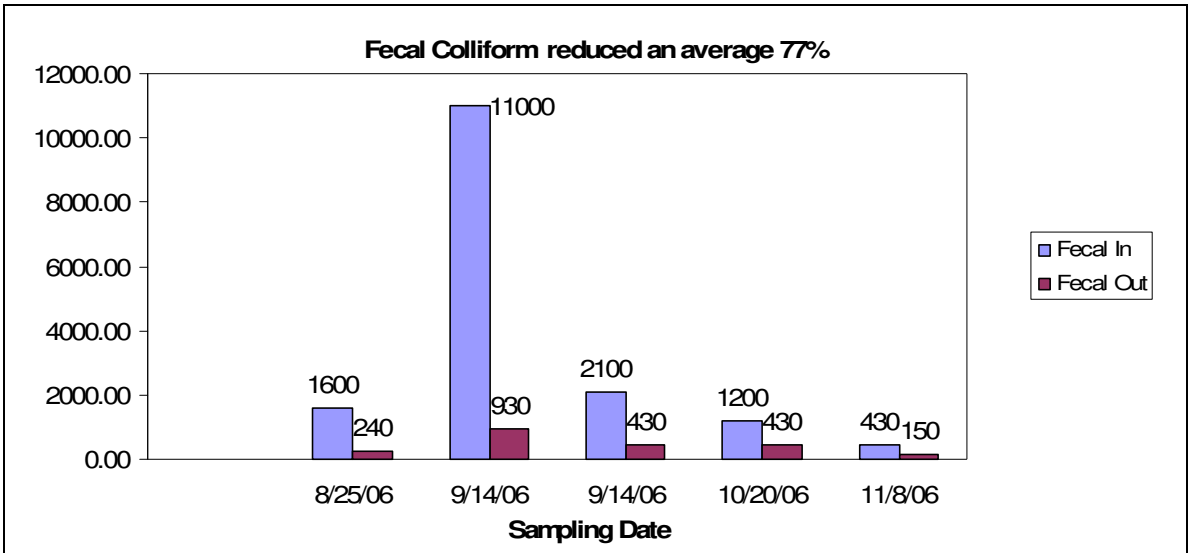
In general, good results were achieved with the use of the auto-sampling equipment. Analytical results indicated that samples collected with the equipment in the automatic mode were comparable to those collected manually.

Table A: Fabco Industries, StormBasin: effectiveness on E. coli bacteria



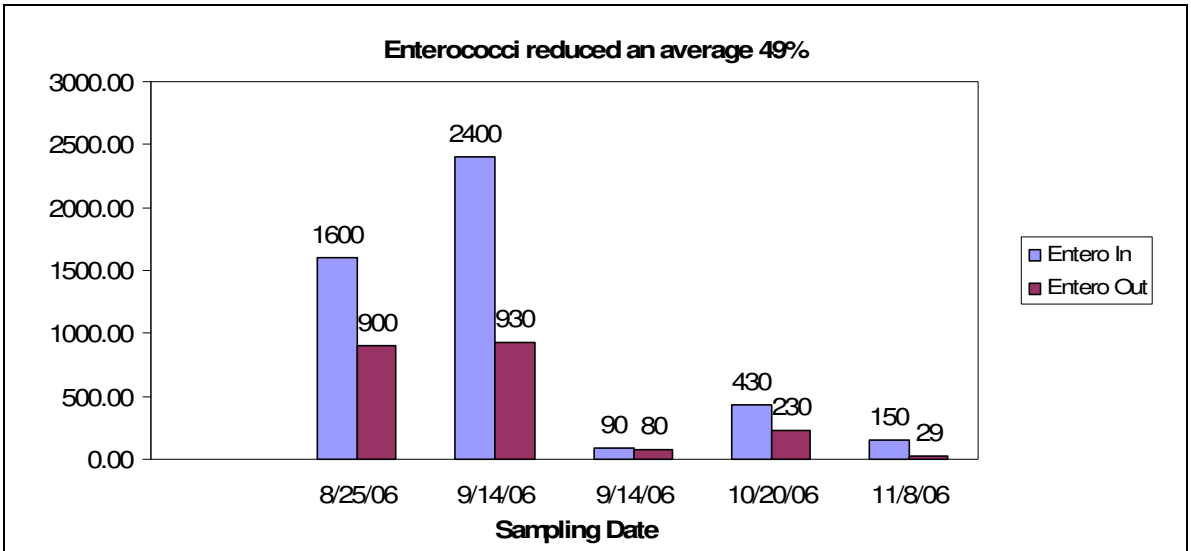
Sample Date	E.coli In	E.coli Out	% Change	Analysis Method	Reporting Limit
8/15/06 Auto	1600	300	81%	SM 18209221B	2
8/25/06 Auto	1600	240	85%	SM 18209221B	2
9/14/06 Auto	4600	930	80%	SM 18209221B	30
9/14/06 Manual	1500	230	85%	SM 18209221B	30
10/20/06 Manual	1200	430	64%	SM 18209221B	30
11/8/06 Manual	430	150	78%	SM 18209221B	30
Average			77%		

Table B: Fabco Industries, StormBasin: effectiveness on Fecal coliform bacteria



Sample Date	Fecal In	Fecal Out	% Change	Analysis Method	Reporting Limit
8/15/06	ND	ND			
8/25/06 Auto	1600	240	85%	SM 18209221B	2
9/14/06 Auto	11000	930	92%	SM 18209221B	30
9/14/06 Manual	2100	430	80%	SM 18209221B	30
10/20/06 Manual	1200	430	64%	SM 18209221B	30
11/8/06 Manual	430	150	65%	SM 18209221B	30
Average			77%		
ND = No data collected					

Table C: Fabco Industries, StormBasin: effectiveness on Enterococci bacteria



Sample Date - Method	Entero In	Entero Out	% Change	Analysis Method	Reporting Limit
8/15/06	ND	ND			
8/25/06 Auto	1600	900	44%	Enterolert	2
9/14/06 Auto	2400	930	61%	Enterolert	30
9/14/06 Manual	90	80	11%	Enterolert	30
10/20/06 Manual	430	230	47%	Enterolert	30
11/8/06 Manual	150	29	81%	Enterolert	30
Average			49%		
ND = No data collected					

References

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used in the preparation of the testing protocol

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United States Environmental Protection Agency, Office of Water (EN-336), Document 833-B-92-001, March 1992: **NPDES Storm Water Sampling Guidance Document**

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Websites for information on bacteria and testing

Eagles to the Nest, http://www.iub.edu/~bradwood/eagles/fecal.htm, Fecal Coliform Test, Class Room Activity

Switzerland County High School's Advanced Placement Environmental Science Class, Fecal Coliform: http://www.switzerland.k12.in.us/watershed/fecal.html

Oasis Designs, Fecal Coliform Bacteria Counts: What They Really Mean about water quality, http://www.oasisdesign.net/water/quality/coliform.htm