UP-FLO™ FILTER

PERFORMANCE REPORT FOR REMOVAL OF SIL-CO-SIL 106

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1.0 INTRODUCTION

The Up-Flo™ Filter is a high rate, modular filtration system designed to meet the most stringent stormwater treatment regulations. It incorporates multiple elements of a treatment train design into a single, small-footprint device. The Up-Flo™ Filter is engineered to remove over 80% of fine TSS and associated pollutants. Filter Media can be customized to target site-specific pollutants. This test evaluated the Sil-Co-Sil 106 removal performance of four separate media mixes: Filter Sand, Hydro International's CPZ Mix™, CPS Mix™ and Perlite.

2.0 THE UP-FLO™ FILTER TEST FACILITY DESCRIPTION

2.1 LABORATORY SET UP

The Hydro International test facility contains a 23,000-gallon clean water storage reservoir equipped with a Flygt submersible pump to distribute feed water. The 3-inch Flygt pump delivers water to the Up-Flo™ Filter through an 8-inch PVC pipe network that freely discharges into the open top of the test tank. The 8-inch PVC delivery line is equipped with clear standpipes and a Hershey VP-820 butterfly valve that redirects flows in excess of the desired influent flow rate back into the feed reservoir. A Watson Marlow 704 S/R peristaltic pump conveys slurry from a slurry tank into the delivery line via a standpipe about 3 feet upstream from the Up-Flo™ Filter.

2.2 UP-FLO™ FILTER CONFIGURATION

The 4-ft x 4-ft polypropylene test tank stands 7-ft high and houses from one (1) to six (6) Up-Flo™ Filter Modules. The test tank has a 12-inch outlet pipe that discharges into a large underflow basin on the floor of the lab. Two, 2-inch Flygt pumps send water from the underflow basin back into the feed reservoir.

A Catch Basin configuration Up-Flo™ Filter equipped with 1 Filter Module was used for testing. Two (2) media bags of a specified filtration media mix were inserted into the Filter Module and the module was latched shut. A more detailed description of the laboratory set-up can be seen Appendix A.

2.3 FLOW RATE

The flow rate to the Up-Flo™ Filter can be adjusted from 0-450 gpm (0.0 - 1.0 cfs) using the notched Hershey VP-820 butterfly valve fixed to the delivery pipework.

The filtration capacity of a Filter Module depends on the filter media housed within the module and the height of (water) driving head acting on the filter media. This test evaluated the performance of a one-module set up with a flow capacity of 25 gpm at 20 inches of driving head. To test the Filter Module at steady state conditions, the influent flow rate was set to 25 gpm.

2.4 INFLUENT FEED SAND GRADATION

The Up-Flo™ Filter targets the removal of fine sediment. Commercially available feed sands of different grades are selected to best represent the sediment likely to be encountered at a project location. For this Up-Flo™ Filter test, Sil-Co-Sil 106 (a ground silica gradation available from U.S. Silica, Inc.) was used as the feed pollutant. Sil-Co-Sil 106 has a particle size gradation with 100% of particles smaller than 212 microns in diameter and 75% of particles smaller than 45 microns in diameter. The particle size distribution for Sil-Co-Sil 106 can be found in Appendix B.

2.5 SEDIMENT LOADING

This test targeted a sediment loading concentration in the 100 – 300 mg/L range. For flow rates suitable for the one-Filter Module set-up, 1.25 lbs Sil-Co-Sil 106 was adequate for attaining the desired influent sediment load.

3.0 TESTING PROCEDURE

3.1 PARTICLE SIZE DISTRIBUTION

Particle size analysis was performed on each blend to ensure that it conforms to the target gradation. Because Sil-Co-Sil 106 is composed of very fine particles, the particle size distribution was tested according to ASTM D422 (AASHTO T88).

3.2 FLOW RATE CALIBRATION

A 3-inch, non-variable Flygt pump delivered flows at a constant rate of 448 gpm (1.0 cfs). A series of butterfly valves, a Hersey VP-820 valve and a notched Hershey VP-812 valve, were used to step the flow down to the desired influent flow rate of 25 gpm (for CPZ Mix™), 23 gpm (for Filter Sand), 20 gpm (for CPS Mix™) and 28 gpm (for Perlite) Excess flows were redirected to the storage reservoir. The flow rate was calibrated using the Volumetric Time-To-Fill Method. After the valves had been set to their desired notches, time to fill the tank to the 8-cubic feet mark was recorded. The flow rate equals the volume divided by the time-to-fill the volume.

3.3 TSS PERFORMANCE TESTING

The following sampling procedure was used:

1. Accurately weigh out a bulk sample of the influent feed sand. Ideally, 1.25 lbs should be used for a Sil-Co-Sil 106 slurry mixture being filtered by a 1-Filter Module Up-Flo™ Filter.
2. Start the 3-inch submersible pump and allow it to pump water into the Up-Flo™ Filter test tank until there is enough driving head to start pushing water up through the filter. Continue to pump flows into the tank until the desired operating head of 20 inches is reached. When the water is at 20 inches of operating head, use the butterfly valves to reduce the influent flows until they are equal to the effluent flows, stabilizing the water level within the Up-Flo™ Filter test tank.
3. Start the stopwatch and switch on the Watson Marlow peristaltic pump to begin feeding the influent feed slurry into the 6-inch diameter standpipe in the Up-Flo™ Filter line at a constant rate.
4. While the sand is being fed, watch the water level in the test chamber at regular intervals. Be sure that the water level in the chamber is not rising or falling below 20 inches of operating head. If the water level is rising or falling, adjust the flow rate accordingly and steady it at 20 inches of operating head.
5. When steady-state conditions have been reached (12 minutes for a flow rate of 25 gpm), take paired samples of the influent and effluent. Two lab technicians may be required to take the samples simultaneously. Be sure to sample over the entire cross section of the influent and effluent stream.
6. Take at least five (5) more samples at 1 minute intervals. This yields a total of at least 12 samples.
7. When sampling is complete, stop the influent feed pumps and slurry stirring motor.
8. Drain the test unit. Flush the test unit out twice. Clean the test unit and prepare for the next round of testing.

4.0 ANALYSIS

4.1 SAMPLE ANALYSIS

A total of up to 15 pairs of influent and effluent samples for each media mix were collected during three different laboratory trials. The samples were analyzed using an equivalent standard to the SSC Test Method 2 Filtration in ASTM, 1999, D 3977-97.

4.1.1 CPZ Mix™

The CPZ Mix™ is a proprietary blend of activated carbon, peat and manganese-coated zeolite. The proportions and gradations of activated carbon, peat and manganese-coated zeolite have been adjusted for high pollutant removal efficiencies while allowing a high hydraulic throughput.

A total of 15 paired influent and effluent samples were analyzed for Suspended Sediment Concentration. All influent samples had a SSC concentration in the 200 – 300 mg/L range, while all effluent samples were in the 28 – 40 mg/L range (see Figure 4-1).

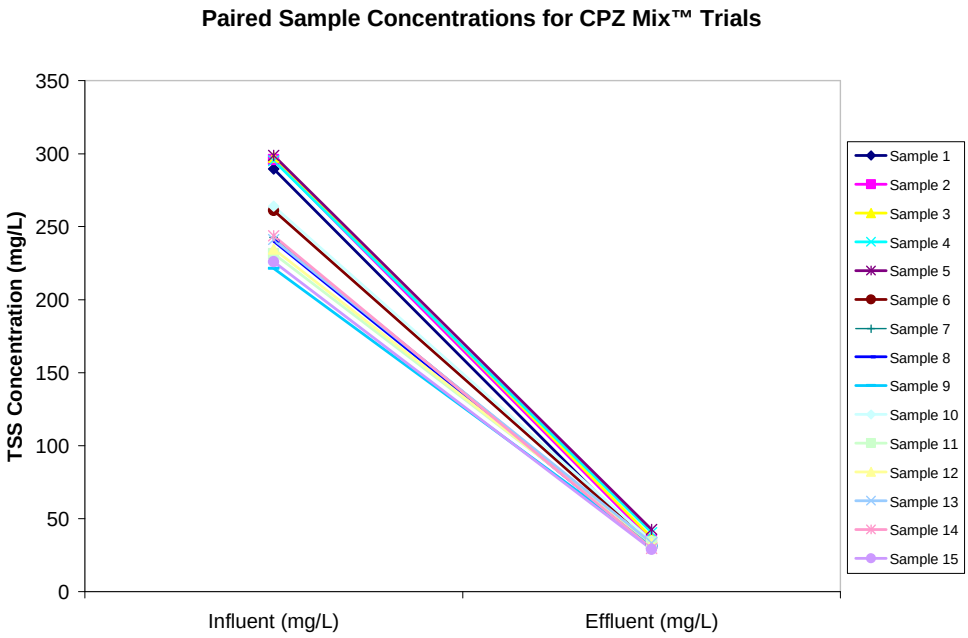

Figure 4-1: Paired influent and effluent Sil-Co-Sil 106 concentrations for CPZ Mix™ trials

4.1.2 Filter Sand

The hard ore quartz filter sand that was tested is a traditional non-reactive filter media. The gradation is carefully selected to optimize both pollutant removal efficiencies and hydraulic throughput.

A total of 17 paired influent and effluent samples were analyzed for Total Suspended Solids concentration. All influent samples had a SSC concentration in the 190 – 300 mg/L range, while all effluent samples were in the 10 – 42 mg/L range (see Figure 4-2).

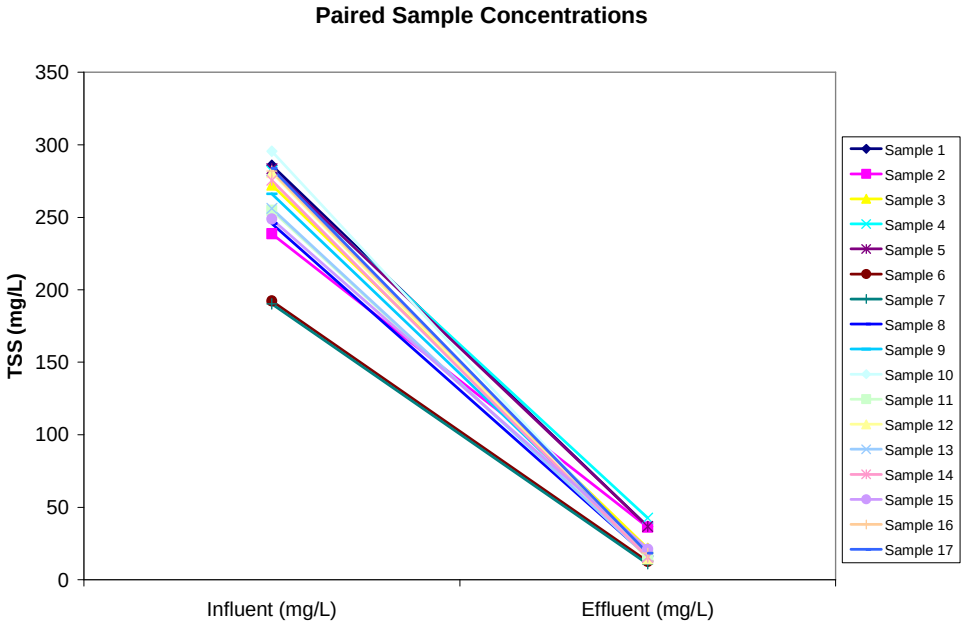

Figure 4-2: Paired influent and effluent Sil-Co-Sil 106 concentrations for Filter Sand trials

4.1.3 CPS Mix™

The CPS Mix™ is a proprietary blend of activated carbon, peat and sand. The proportions and gradations of activated carbon, peat and sand have been adjusted for high pollutant removal efficiencies while allowing a high hydraulic throughput.

A total of 10 paired influent and effluent samples were analyzed for Suspended Sediment Concentration. All influent samples had a SSC concentration in the 110 – 300 mg/L range, while all effluent samples were in the 8 – 50 mg/L range (see Figure 4-3).

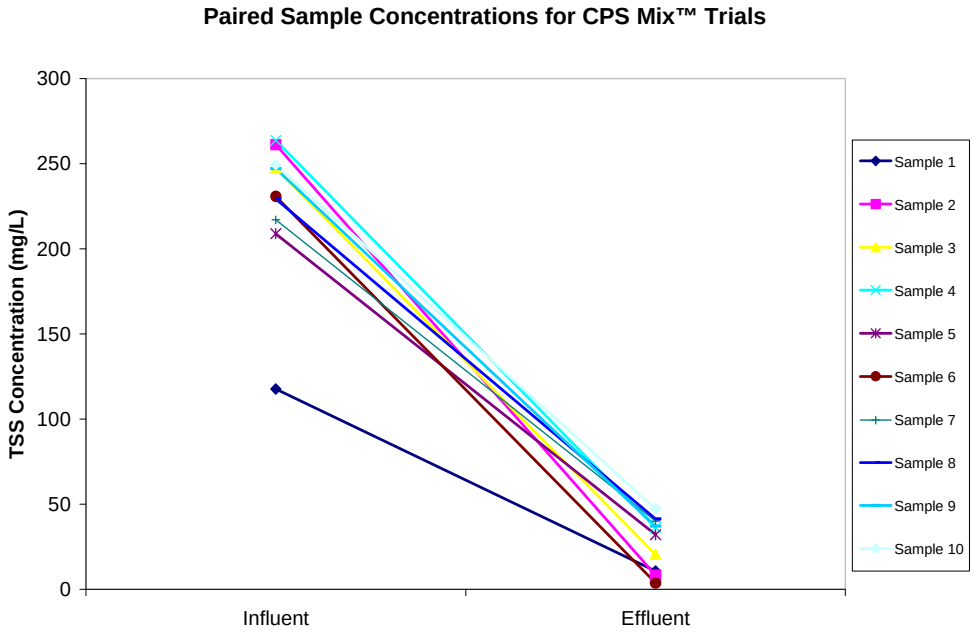

Figure 4-3: Paired influent and effluent Sil-Co-Sil 106 concentrations for CPS Mix™ trials

4.1.4 Perlite

The naturally occurring perlite tested is a traditional non-reactive filter media. The gradation is carefully selected to optimize both pollutant removal efficiencies and hydraulic throughput.

A total of 9 paired influent and effluent samples were analyzed for Total Suspended Solids concentration. All influent samples had a TSS concentration in the 115 – 260 mg/L range, while all effluent samples were in the 3 - 40 mg/L range (see Figure 4-3).

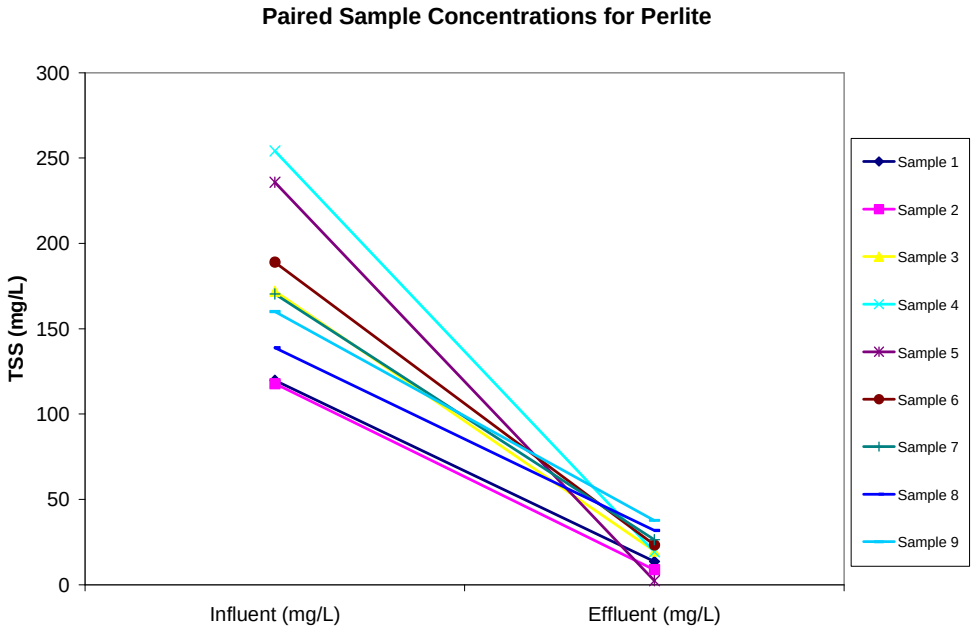

Figure 4-4: Paired influent and effluent Sil-Co-Sil 106 concentrations Perlite trials

4.2 DATA ANALYSIS

The influent and effluent samples were analyzed for Sil-Co-Sil 106 concentration. The percent of Sil-Co-Sil 106 removed was then derived from the concentrations of each paired sample. To ascertain the representativeness of the data, the sample sets were subjected to a Dixon Q's test and an ANOVA analysis.

4.2.1 CPZ Mix™

Figure 4-5 shows the percent of Sil-Co-Sil 106 removed by the CPZ Mix™ during the test trials. The percent of Sil-Co-Sil 106 removed for each sample pair was determined using Equation 1:

Eq. 1 % Removal = 100 x ($[SSC]_{INF} - [SSC]_{EFF}$) / $[SSC]_{INF}$

The average % Removal for each laboratory trial was calculated using Equation 2:

Eq. 2 Avg. % Removal = 100 x ($[SSC]_{AVG\ INF} - [SSC]_{AVG\ EFF}$) / $[SSC]_{AVG\ INF}$

By Equation 2, the average Sil-Co-Sil 106 Removal for all 15 trials is 86.96%.

Paired Samples for CPZ Mix™ Trials

	Sample	Influent (mg/L)	Effluent (mg/L)	% Removed
Sample Set 1	1	289.51	29.89	89.7%
	2	295.89	35.23	88.1%
	3	297.56	36.99	87.6%
	4	295.24	40.48	86.3%
	5	298.73	42.62	85.7%
Sample Set 2	6	261.11	32.37	87.6%
	7	242.67	32.56	86.6%
	8	240.00	30.95	87.1%
	9	221.52	31.76	85.7%
	10	264.00	34.83	86.8%
Sample Set 3	11	231.58	34.12	85.3%
	12	234.67	32.94	86.0%
	13	241.25	33.33	86.2%
	14	243.71	29.55	87.9%
	15	225.97	28.89	87.2%
	AVG	**258.89**	**33.77**	**87.0%**

Figure 4-5: Paired influent and effluent Sil-Co-Sil 106 concentrations and % removed for CPZ Mix™ trials

To evaluate the sample sets for statistical validity, a Dixon's Q analysis was conducted. Figure 4-6 shows that all samples have a $Q < Q_{15}$, thus there are no "outliers" within the samples and the data set may be deemed valid with 99% confidence.

DIXON Q TEST of CPZ Mix™ Trials on Sil-Co-Sil 106

SAMPLE SET			
Influent (mg/L)	**Q** influent	**Effluent (mg/L)**	**Q** effluent
221.52		28.89	
225.97	0.0577	29.55	0.0478
231.58	0.0726	29.89	0.0247
234.67	0.0400	30.95	0.0777
240.00	0.0691	31.76	0.0591
241.25	0.0162	32.37	0.0441
242.67	0.0183	32.56	0.0137
243.71	0.0135	32.94	0.0279
261.11	0.2254	33.33	0.0286
264.00	0.0374	34.12	0.0571
289.51	0.3304	34.83	0.0520
295.24	0.0742	35.23	0.0288
295.89	0.0084	36.99	0.1287
297.56	0.0216	40.48	0.2535
298.73	0.0152	42.62	0.1563

99% confidence Q15=0.475

Figure 4-6: Dixon's Q test for influent and effluent Sil-Co-Sil 106 concentrations during CPZ Mix™ trials

An ANOVA single factor test was conducted on the influent and effluent sample sets to show that the data sets were significantly different. The log values of the influent and effluent concentrations were used, as most water quality data follow a log normal distribution. Figure 4-7 shows the results of the ANOVA analysis. The P-value is shown to be 4.21 E-43, which indicates that the influent and effluent sample sets are significantly different with over 99.9% confidence.

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	17	41.024	2.413	0.003
Column 2	17	22.135	1.302	0.031

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	10.49407	1	10.494	621.580	1.56E-22	4.149
Within Groups	0.540252	32	0.017			
Total	11.034	33				

Figure 4-7: ANOVA regression analysis for Sil-Co-Sil 106 concentrations of paired influent and effluent samples for CPZ Mix™ trials

4.2.2 Filter Sand

Figure 4-8 shows the percent of Sil-Co-Sil 106 removed by the Filter Sand during the test trials. The percent of Sil-Co-Sil 106 removed for each sample pair was determined using Equation 1 and the average percent removal for the data set was calculated using Equation 2. As shown in Figure 4-8, the average Sil-Co-Sil 106 removal for all 17 trials is 91.66%.

Paired Samples for Filter Sand Trials

	Sample	Influent (mg/L)	Effluent (mg/L)	% Removed
Sample Set 1	1	285.92	36.81	87.1%
	2	238.60	36.36	84.8%
	3	272.39	21.84	92.0%
	4	281.94	42.68	84.9%
	5	283.54	36.78	87.0%
Sample Set 2	6	192.31	12.75	93.4%
	7	190.34	10.98	94.2%
	8	245.71	16.26	93.4%
	9	266.18	18.42	93.1%
	10	295.59	16.44	94.4%
	11	254.69	16.78	93.4%
Sample Set 3	12	280.90	14.67	94.8%
	13	256.21	15.79	93.8%
	14	275.56	15.58	94.3%
	15	248.86	21.18	91.5%
	16	281.93	18.29	93.5%
	17	283.70	18.40	93.5%
	AVG	**295.62**	**24.67**	**91.7%**

Figure 4-8: Paired influent and effluent Sil-Co-Sil 106 concentrations and % removed for Filter Sand trials

To evaluate the sample sets for statistical validity, a Dixon's Q analysis was conducted. Figure 4-9 shows that all samples have a $Q < Q_{17}$, thus there are no "outliers" within the samples and the data set may be deemed valid with 99% confidence.

DIXON Q TEST of Filter Sand Trials on Sil-Co-Sil 106

SAMPLE SET			
Influent (mg/L)	**Q** influent	**Effluent (mg/L)**	**Q** effluent
190.34		10.98	
192.31	0.0187	12.75	0.0558
238.60	0.4398	14.67	0.0606
245.71	0.0676	15.58	0.0289
248.86	0.0299	15.79	0.0065
254.69	0.0553	16.26	0.0148
256.21	0.0145	16.44	0.0056
266.18	0.0947	16.78	0.0109
272.39	0.0591	18.29	0.0476
275.56	0.0301	18.40	0.0032
280.90	0.0508	18.42	0.0008
281.93	0.0098	21.18	0.0869
281.94	0.0002	21.84	0.0209
283.54	0.0152	36.36	0.4581
283.70	0.0014	36.78	0.0132
285.92	0.0211	36.81	0.0009
295.59	0.0919	42.68	0.1852

99% confidence Q17=0.495

Figure 4-9: Dixon's Q test for influent and effluent Sil-Co-Sil 106 concentrations during Filter Sand trials

An ANOVA single factor test was conducted on the influent and effluent sample sets to show that the data sets were significantly different. The log values of the influent and effluent concentrations were used, as most water quality data follow a log normal distribution. Figure 4-10 shows the results of the ANOVA analysis. The P-value is shown to be 1.56 E-22, which indicates that the influent and effluent sample sets are significantly different with over 99% confidence

ANOVA: Single Factor - Log Influent and Effluent for Filter Sand Trials

SUMMARY

Groups	Count	Sum	Average	Variance
Log (Influent, mg/L)	17	41.024	2.411	0.003
Log (Effluent, mg/L)	17	22.135	0.382	0.031

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10.494	1	10.494	621.580	1.56E-22	4.149
Within Groups	0.540	32	0.017			
Total	11.034	33				

Figure 4-10: ANOVA regression analysis for Sil-Co-Sil 106 concentrations of paired influent and effluent samples for Filter Sand trials

4.2.3 CPS Mix™

Figure 4-11 shows the percent of Sil-Co-Sil 106 removed by the CPS Mix during the test trials. The percent of Sil-Co-Sil 106 removed for each sample pair was determined using Equation 1 and the average percent removal for the data set was calculated using Equation 2. As shown in Figure 4-11, the average Sil-Co-Sil 106 removal for all 10 trials is 87.8%.

Paired Samples for CPS Mix™ Trials

Sample	Influent (mg/L)	Effluent (mg/L)	% Removed
1	117.647	10.769	90.8%
2	261.176	8.333	96.8%
3	247.436	20.588	91.7%
4	263.576	36.364	86.2%
5	208.861	32.143	84.6%
6	230.769	3.704	98.4%
7	217.045	40.000	81.6%
8	229.268	41.322	82.0%
9	247.126	37.143	85.0%
10	249.351	47.222	81.1%
AVG	**151.48**	**18.51**	**87.8%**

Figure 4-11: Paired influent and effluent Sil-Co-Sil 106 concentrations and % removed for CPS Mix trials

To evaluate the sample sets for statistical validity, a Dixon's Q analysis was conducted. Figure 4-12 shows that all samples have a $Q < Q_{10}$, thus there are no "outliers" within the samples and the data set may be deemed valid with 99% confidence.

DIXON Q TEST of CPS Mix™ Trials on Sil-Co-Sil 106

SAMPLE SET			
Influent (mg/L)	**Q** influent	**Effluent (mg/L)**	**Q** effluent
117.65		3.70	
208.86	0.5891	8.33	0.1276
217.05	0.0529	10.77	0.0671
229.27	0.0789	20.59	0.2705
230.77	0.0097	32.14	0.3183
247.13	0.1056	34.90	0.0758
247.44	0.0020	36.36	0.0405
261.18	0.0887	37.14	0.0215
263.58	0.0155	40.00	0.0787
272.48	0.0575	41.32	0.0364

99% confidence Q10=0.568

Figure 4-12: Dixon's Q test for influent and effluent Sil-Co-Sil 106 concentrations during Filter Sand trials

An ANOVA single factor test was conducted on the influent and effluent sample sets to show that the data sets were significantly different. The log values of the influent and effluent concentrations were used, as most water quality data follow a log normal distribution. Figure 4-13 shows the results of the ANOVA analysis. The P-value is shown to be 8.32 E-08, which indicates that the influent and effluent sample sets are significantly different with over 99% confidence

CPS Mix Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	10	23.51007	2.351007	0.011106
Column 2	10	13.2339	1.32339	0.130992

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5.27998	1	5.27998	74.31473	8.32E-08	4.413863
Within Groups	1.27888	18	0.071049			
Total	6.55886	19				

Figure 4-13: ANOVA regression analysis for Sil-Co-Sil 106 concentrations of paired influent and effluent samples for CPS Mix trials

4.2.4 Perlite

Figure 4-14 shows the percent of Sil-Co-Sil 106 removed by the CPS Mix during the test trials. The percent of Sil-Co-Sil 106 removed for each sample pair was determined using Equation 1 and the average percent removal for the data set was calculated using Equation 2. As shown in Figure 4-14, the average Sil-Co-Sil 106 removal for all 9 trials is 88.3%.

Paired Samples for Perlite Trials

Sample	Influent (mg/L)	Effluent (mg/L)	% Removed
1	119.753	13.580	88.7%
2	117.808	8.750	92.6%
3	171.975	19.718	88.5%
4	254.167	19.178	92.5%
5	235.762	2.326	99.0%
6	188.957	23.256	87.7%
7	170.370	26.374	84.5%
8	138.889	31.818	77.1%
9	160.000	37.647	76.5%
AVG	**103.85**	**12.18**	**88.3%**

Figure 4-14: Paired influent and effluent Sil-Co-Sil 106 concentrations and % removed for Perlite trials

To evaluate the sample sets for statistical validity, a Dixon's Q analysis was conducted. Figure 4-15 shows that all samples have a $Q < Q_9$, thus there are no "outliers" within the samples and the data set may be deemed valid with 99% confidence.

DIXON Q TEST of Perlite Trials on Sil-Co-Sil 106

SAMPLE SET			
Influent (mg/L)	**Q** influent	**Effluent (mg/L)**	**Q** effluent
117.81		2.33	
119.75	0.0126	8.75	0.1973
127.27	0.0486	13.58	0.1483
138.89	0.0751	19.18	0.1719
170.37	0.2035	19.72	0.0166
171.97	0.0104	23.26	0.1086
188.96	0.1098	26.37	0.0957
235.76	0.3026	31.82	0.1672
254.17	0.1190	34.90	0.0945
272.48	0.1184		

99% confidence Q10=0.568

Figure 4-15: Dixon's Q test for influent and effluent Sil-Co-Sil 106 concentrations during Perlite trials

An ANOVA single factor test was conducted on the influent and effluent sample sets to show that the data sets were significantly different. The log values of the influent and effluent concentrations were used, as most water quality data follow a log normal distribution. Figure 4-16 shows the results of the ANOVA analysis. The P-value is shown to be 2.14E-07, which indicates that the influent and effluent sample sets are significantly different with over 99% confidence

Perlite Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	10	22.35301	2.235301	0.01851
Column 2	9	10.85227	1.205807	0.133379

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5.020376	1	5.020376	69.18353	2.14E-07	4.451323
Within Groups	1.233623	17	0.072566			
Total	6.253998	18				

Figure 4-16: ANOVA regression analysis for Sil-Co-Sil 106 concentrations of paired influent and effluent samples for Perlite trials

5.0 CONCLUSIONS

The Up-Flo™ Filter has been tested at full scale using Sil-Co-Sil 106 as the test sediment. Influent concentrations were maintained in the 110 – 300 mg/L range at an operating head of 20 inches. Test conducted for four specified filter media mixes, CPZ Mix™ ,Filter Sand, CPS Mix and Perlite show removals of 86%, 91%, 88% and 88% at 25 gpm , 23 gpm, 20 gpm and 28 gpm respectively per Filter Module. Dixon's Q tests show 99.9% confidence that there were no outliers amongst the influent and effluent sample sets. ANOVA analyses show with over 99.9% confidence that the effluent sample set is significantly different from the influent sample set.

APPENDIX A - TEST UNIT AND FACILITY DETAILS

Description of the Up-Flo™ Filter

A full description of the system components and functionality of the Up-Flo™ Filter is presented in a Flash Animation File found on Hydro International's web page http://www.hydro-international.biz/.

Test unit description

The test unit is fabricated from polypropylene and takes the form of a 4-ft x 4-ft square chamber cylinder approximately 7 ft (2.1m) high. The internal polypropylene components and Type 304 stainless steel support frame are the same as found in actual units. There is no inlet. The set-up simulates a catch-basin insert technology which treats stormwater runoff pouring into a chamber from an overhead grate. The outlet is flanged with a 12 in. (300mm) NP16 flange. The relevant levels are as shown in the drawings and flash animation.

In order to clean out the unit and view the sediment storage area, an 18 in. (460mm) access hatch with a clear viewing port is located at sump level.

The 4-ft square Up-Flo™ Filter test unit has an effective treatment volume equal to:

$V = l \cdot w \cdot h$ = ft = 40.0 ft^3 (1.13 m^3); where h=2.5 ft, l=w=2 ft

- where l = length of treatment unit
  w= width of treatment unit
  h = distance between top of sump volume and invert of internal bypass weir (which excludes the sediment storage area in the sump).

The theoretical residence time is equal to the amount of time it takes one (1) unit volume to pass through the system at a given flow rate assuming plug flow conditions (no underflow).

The residence time for the Up-Flo™ Filter depends on the peak treatment flow rate. The peak treatment flow rate depends on the number of Filter Modules included in the system as well as the media housed within the Filter Modules. The following residence time calculation is for one (1) Filter Module housing the CPZ Mix™:

t_r = treatment volume/flow rate = (300 gal)/(25 gal/min) = 12 minutes

Test Facility General Arrangement

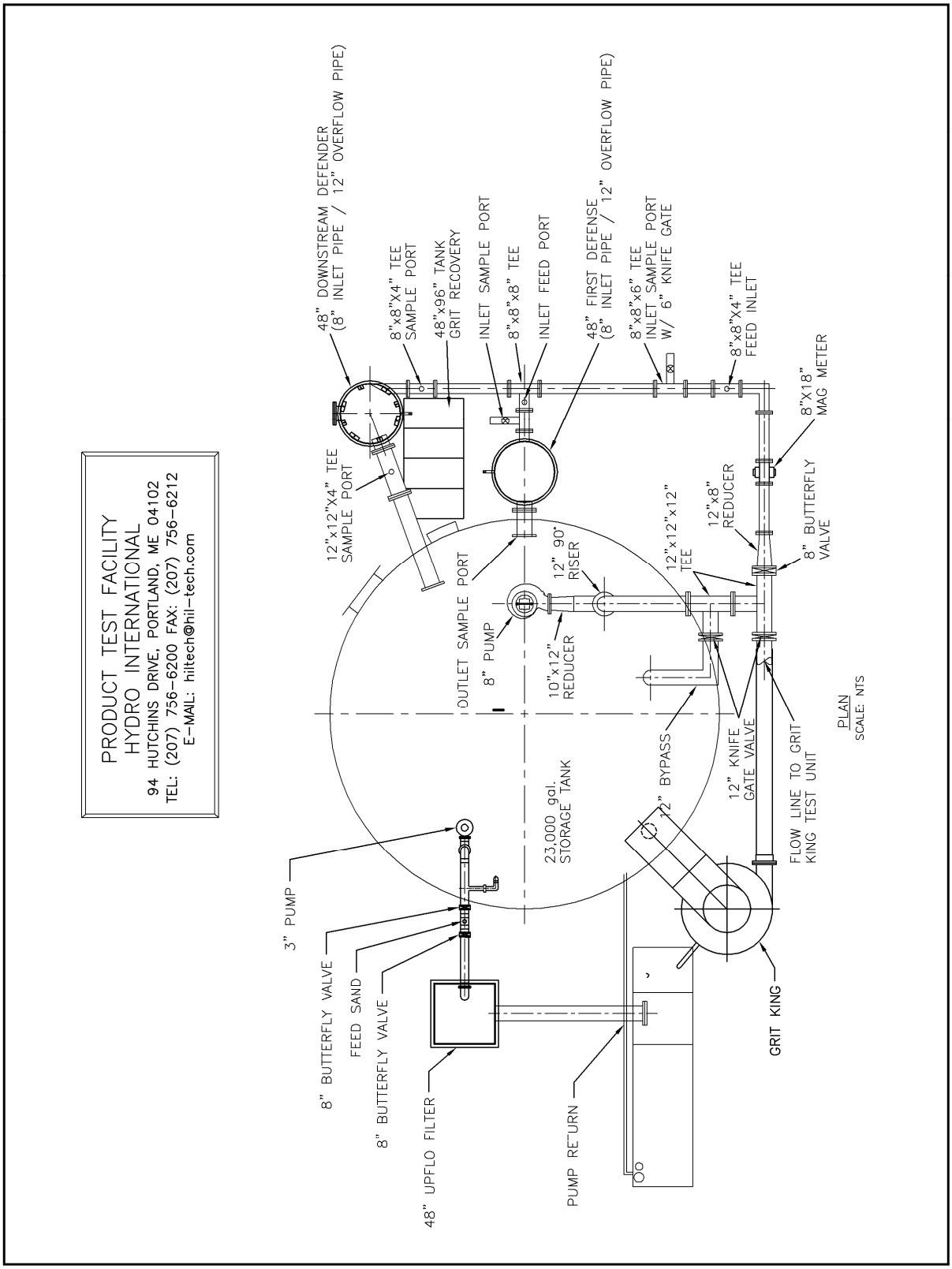

Figure A-1: General Arrangement drawing of the Hydro International hydraulic testing facility in Portland, Maine

Test unit photographs

Figure A-2: View showing Up-Flo™ Filter overhead Inlet Pipe, Outlet Pipe and Collection Basin

Figure A-3: View Showing a One-Filter Module Set-Up

Figure A-4: View showing closed and opened Filter Modules

Figure A-5: View showing media bag with Filter Sand being installed in the Filter Module

Figure A-6: A close-up view of the Filter Sand

Figure A-7: A close-up view of the Hydro International *CPZ Mix*™

APPENDIX B – PARTICLE SIZE DISTRIBUTION OF SIL-CO-SIL 106

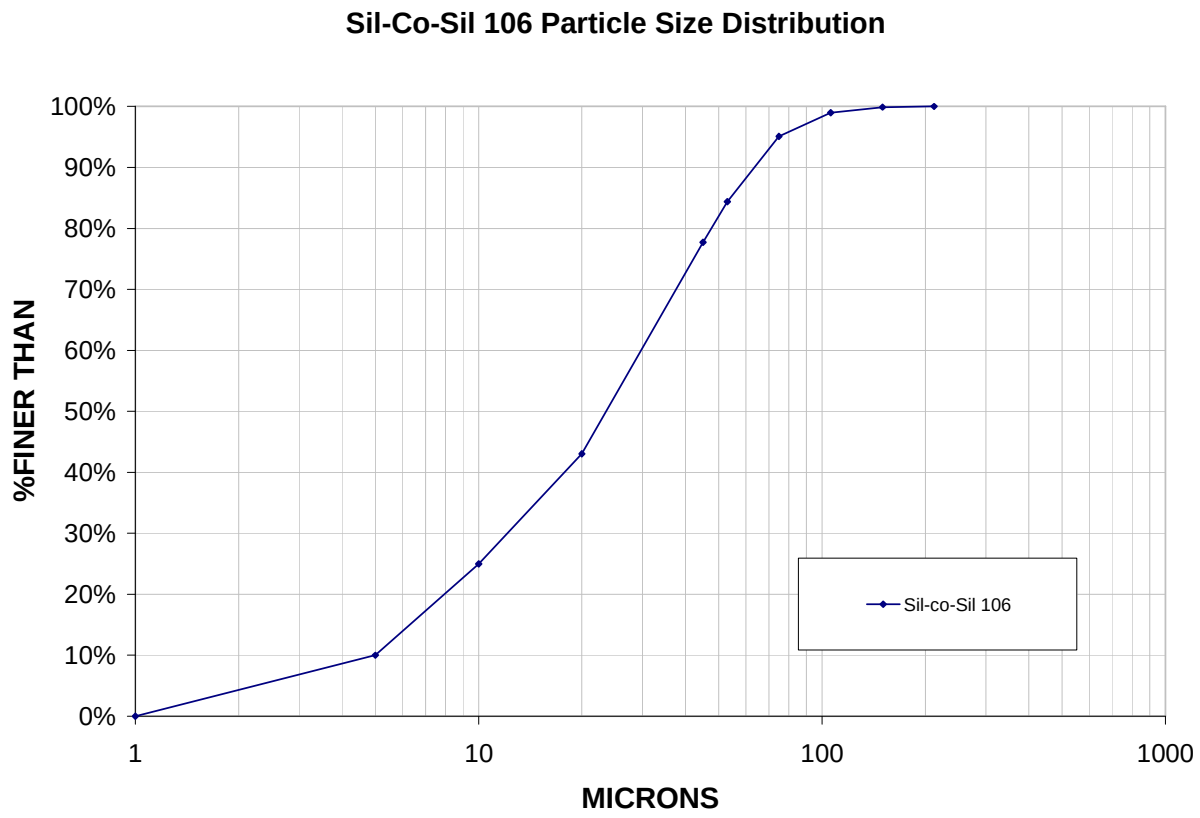

Figure B-1: Particle Size Distribution of Sil-Co-Sil 106