NJCAT Technology Verification

Quality Assurance Project Plan

Hydrosystem – Stormwater Filtration Device

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1 Description of Technology

The Hydrosystem stormwater treatment device consists of a hydrodynamic separator and a filter unit, that are installed within standard shafts of concrete or plastic. It is easy to inspect and maintain. The usual inspection interval is once a year. There is only low head loss. Filter media is kept in cartridges, there is no loose material in the system. Filter media must be replaced in intervals between 3 and 5 years depending on the sites conditions. There is virtually no surface footprint because the system can be installed below car parks or roads (Figure 1).

The filter media removes pollutants like PAH´s, hydrocarbons and heavy metals. Furthermore. it binds phosphorous and ammonium from stormwater runoff. The two-step treatment train removes solids and dissolved substances separately.

The system is designed for car parks, roads, industrial areas and even metal roofs. Therefore, two different filter cartridges for traffic areas and metal roofs are available. Highest pollutant levels in stormwater runoff can be reduced to acceptable loads for groundwater and surface waters discharge. The modular design allows the adaption to nearly any site condition.

Figure 1. Hydrosystem 1000 in front of an underground infiltration facility

Technical data

- Inner diameter of concrete or plastic shaft for standard systems: 1.0 m (3.3 ft) to 1.5 m (4.9 ft) (Figure 2)
- Customized systems with other dimensions are possible, the scaling regulations of chapter 6 of the document "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device." dated January 25, 2013 must be considered
- Minimum head loss between inlet and outlet: 10 in (254 mm)
- Connectable area: 0.25 acres (1,000 m^2) to 0.56 acres (2,250 m^2) for standard types DN 1000 and DN 1500

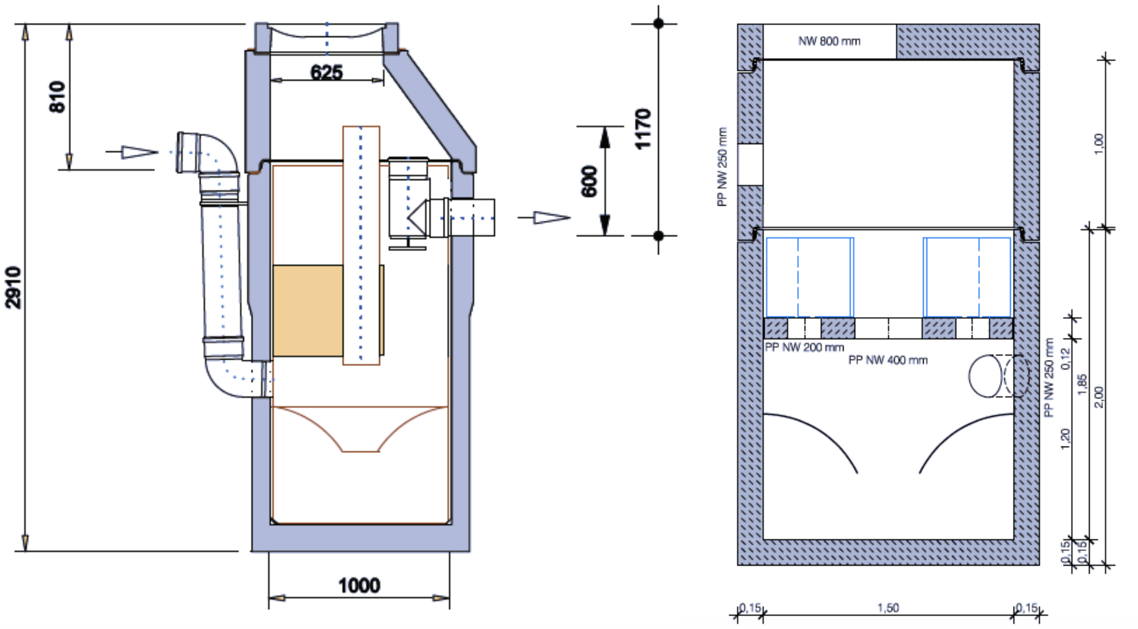


Figure 2. Typical setup of Hydrosystem DN 1000 and DN 1500 in concrete shafts

The filter works by an up-flow process with low head loss. In the system, stormwater runoff is cleaned by sedimentation, adsorption, filtration and chemical precipitation. Incoming stormwater is discharged into the base section of the filter shaft. A conical, hydrodynamic separator promotes circular flow and sedimentation. Particles settle in the silt trap located below the separation funnel. Above the separation chamber 4 (Figure 3) to 6 filter cartridges are installed in a false floor, occupying the full shaft width such that all water must flow upwards through the filters. Clogging of the filters is reduced due to the upwards flow, and the fact that the filter cartridges are always below the water level. The filter cartridges can be easily exchanged. The system is maintained and back flushed typically once a year.

Figure 3. View from the top in a concrete shaft version

Working Principle (Figure 4)

1. The stormwater runoff is fed into the base section of the system. The angled inlet generates a radial flow pattern.
2. The conical hydrodynamic separator converts turbulent waters into a radial laminar flow pattern, encouraging particle sedimentation, particularly of the sand and silt particle sizes.
3. The sediment is retained in a sediment trap chamber below the separator. The silt trap needs to be emptied out at site specific intervals.
4. The water must pass through an upflow filter device built of four to 6 cartridges. Different filter media is available to target different pollutant loads from traffic areas or metal roofs. In the filter element, filtration, adsorption and precipitation takes place. The filter cartridges can be backwashed. The filter elements can be exchanged through the shaft opening.
5. The treated water exits via an oil baffle and leaves the system by the outlet.

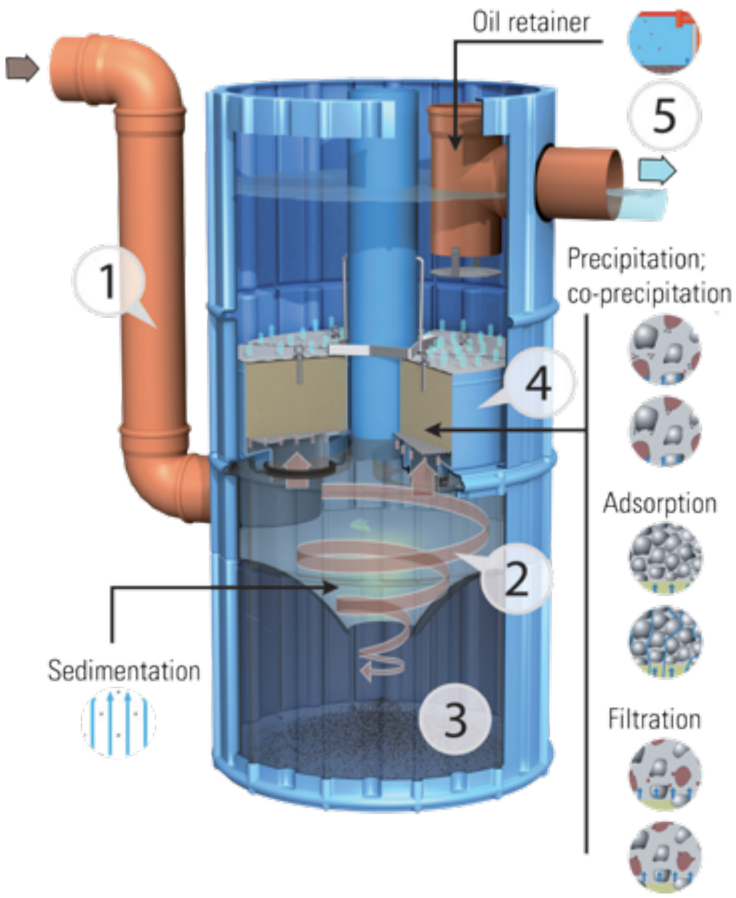


Figure 4. Working Principle

2 Laboratory Testing

A preliminary test for this QAPP was conducted in November and December 2016 at a full-scale testing facility of 3P Technik Filtersysteme GmbH in Bad Überkingen/Germany. The official test will be carried out after the QAPP is accepted by the New Jersey Cooperation for Advances Technology (NJCAT).

2.1 Test Setup

The system will be tested according to the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (MTD)." dated January 25, 2013. The process requires the submittal of a Quality Assurance Project Plan (QAPP) to the New Jersey Cooperation for Advances Technology (NJCAT) for review and approval prior to testing to ensure that all laboratory procedures will be conducted in strict accordance with the NJDEP protocol. Therefore, nearly all tests were carried out once before the official test will be done.

Laboratory testing evaluates the MTD's treatment process, determines performance and assess expected lifespan. The tests were conducted by the manufacturer, 3P Technik Filtersysteme GmbH. Laboratory testing for the official test will be performed under the direct supervision of an independent third party observer. Dr.-Ing. Martina Dierschke is suggested to supervise the tests. Dr.-Ing. Dierschke's qualifications are included in the Appendix.

Analytical testing is defined as the evaluation of total suspended solids in accordance with ASTM D3977-97. This test will be conducted in the laboratory of 3P Technik Filtersysteme GmbH under the direct supervision of Dr. Martina Dierschke.

The samples of the particle distribution curve of the test sediment will be tested by a commercial laboratory that is certified under ISO9001 Quality standards.

A full-scale unit of a Hydrosystem 1000 (four cartridges in a 1.00 m (3.3 ft) chamber) will be tested (Figure 5, Figure 6). Influent water will be drawn from a 6,600 gal underground rainwater harvesting tank. Water from the 3P Technik warehouse roof is collected and is used for the tests. The water will be pumped by one to three electric and gasoline pumps from the tank to the laboratory. The flowrate into the system will be controlled by mechanical flow regulators. The flowrate for the sediment removal efficiency test will be monitored using a Zenner flowmeter (Figure 9) with data logger that was officially calibrated in 2016. It generates one signal per 10 L (2.64 gal) of water and was connected to a USB data logger (Omega EL-USB 5). For the scour test a calibrated variable area flowmeter (Krohne K20, accuracy ± 2,5 %) (Figure 8) will be used. Flow rates will be logged by hand.
Influent samples of the water will be taken directly at the inlet of the Hydrosystem. The water temperature will be measured every hour during the test period, it is anticipated to always be below 80 °F as it is stored in an underground tank.

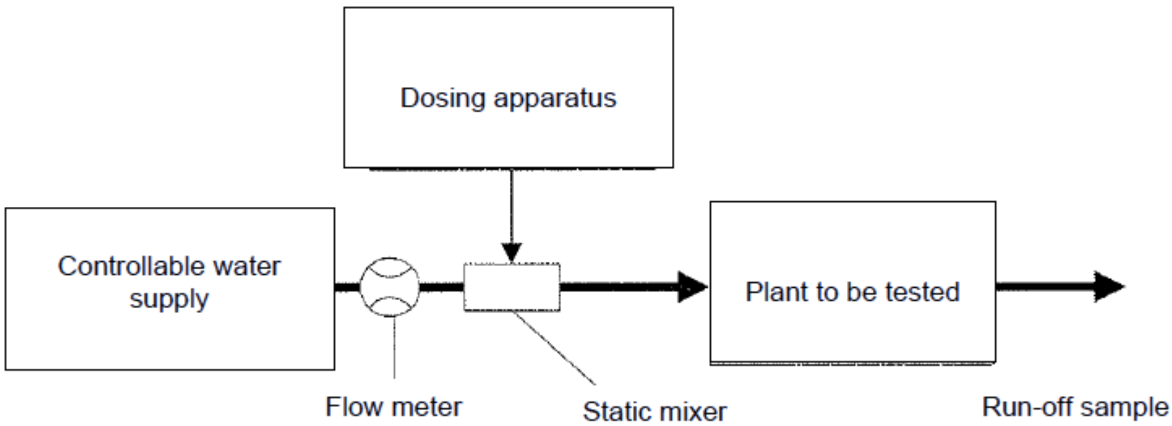


Figure 5.: Test setup

Figure 6.: Laboratory testing arrangement

For supplying the test sediment, a screw feeder from K-Tron Design was used (Figure 7). Screw feeding units use Coperion K-Tron's unique Powersphere design with horizontal agitation to provide the most uniform fill of material into the discharge screw thus improving feeding accuracy over a greater turndown range. A twin-screw configuration was used with a variety of screw designs to accommodate the broad range of materials that must be fed. The model is K-TRON K-MV-KT20.

Figure 7. K-Tron Screw feeder from inside

Figure 8. Flow-meter for high flow rates (scour test)

Figure 9. Flow-meter for low flow rates (sediment removal test)

Figure 10. Sediment sampling

2.2 Test Sediment

As there was no sediment with the proposed PSD on the German market, a Sil-Co-Sil 106 was ordered in the USA. The specific gravity of the material is 2.65 g/cm^3.
The PSD from the manufacturer is given in Figure 11 in comparison to the NJDEP required material.

Table 1. Particle size distribution of test media

Particle Size (Microns)	Target Minimum % Less Than
1.000	100
500	95
250	90
150	75
100	60
75	50
50	45
20	35
8	20
5	10
2	5

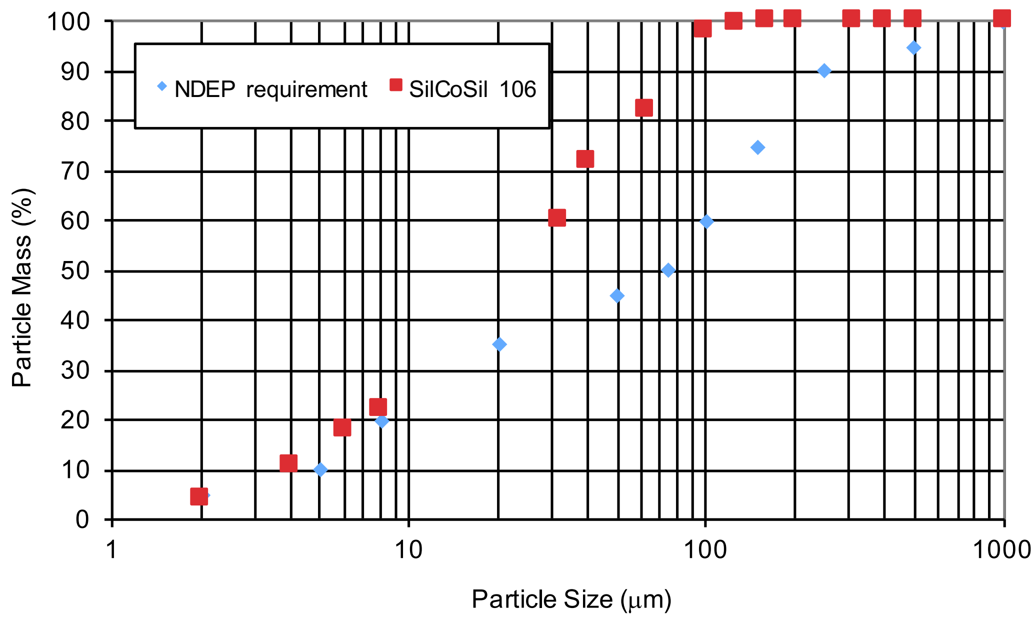


Figure 11. Average PSD of testing sediment compared to protocol specification

2.3 Sediment Removal Efficiency testing

The system will be tested for its sediment removal efficiency. In accordance with the NJDEP filtration protocol Section 5, this will be tested in the laboratory. The removal efficiency testing will be carried out by repeatedly testing the unit at maximum treatment flowrate (MTFR) until the design operating head is reached. Influent TSS dosing will be determined by sampling the dosing mass over 1 minute (Figure 10). The time for each influent and effluent samples will be recorded. The samples will be collected in clean 1 liter bottles of brown glass.

The test sediment feed rate will be adjusted to 200 mg/L during the first 10 tests. As there is no increase in head loss anticipated more test runs will be carried out at 400 mg/L feed rate. The feeding will be carried out with an accuracy of ±10 %. The sediment will be injected directly into the inflowing pipe (200 mm inner diameter). The turbulence in the downpipe guarantees a mixing of the sediment before it enters the treatment unit.

Samples of the sediment mass will be taken at the beginning, in the middle and at the end of one test run.

Water levels will be obtained manually from a fixed scale in the central overflow pipe in the system (Figure 12). Heads were protocolled every five minutes during the test runs.

Grab Sampling method will be used to take the water samples. The average inflow TSS concentration will be calculated using the inflow sediment mass over one minute divided by the volume of the water that flowed through the MTD during dosing. The flow over one minute will be obtained from the average flow through the unit during the dosing time.

Once a constant feed of test sediment and flow rate is established, the first effluent sample will be taken after three MTD detention times have passed. All sampling times will be recorded throughout each 35 minute test run.

The time interval between sequential samples will be evenly spaced during the remaining test sediment feed period.

All effluent samples will be analyzed for TSS in accordance with ASTM 3977-97 “Standard test Methods for Determining Sediment Concentrations in Water Samples” in the 3P Technik laboratory under supervision of the 3rd party observer.

2.4 Sediment Mass Loading Capacity

Sediment mass loading capacity will be obtained from the test runs as it can be seen as an example in Table 2. Altogether 23.5 LBS were supplied during the pre-tests. The aim of the official test is to retain 150 LBS (68 kg), so more and longer tests with 400 mg/L feed will be necessary.

Table 2. Sediment Mass Loading during the tests

Test run	Sediment Mass
1	1.72 lbs (780.3 g)
2	1,71 lbs (777.7 g)
3	1.73 lbs (782.5 g)
4	1.12 lbs (505.7g)
5	1.04 lbs (470.1 g)
6	1.13 lbs (512.1 g)
7	1.11 lbs (505.2 g)
8	1.11 lbs (505.2 g))
9	1.11 lbs (505.2 g)
10	1.11 lbs (505.2 g)
11	4.15 lbs (1882.3 g)
12	4.01 lbs (1818.9 g)
13	2.26 lbs (1024.4 g)
Mass	23.31 lbs (10574.6 g)

2.5 Scour Testing

Scour testing will be carried out after the sediment removal tests. One day before the test is to be the background concentration in the rainwater tank will be checked. If it is too high (>20 mg/L), the water will be taken from the drinking water supply.

The test will be carried out under the following boundary conditions:

- The sediment chamber will be pre-loaded to 50 % of the maximum storage volume
- Three samples of the test sediment will be sent to a commercial laboratory for PSD analysis
- Background concentration will be < 20 mg/L
- The flowrate will be adjusted at 119 gal/min within 5 minutes
- Background TSS concentration will be less than 20 mg/L. 8 background samples will be taken during the test
- Effluent samples will be collected and time stamped every 2 minutes. A minimum of 15 samples will be collected over the duration of the test
- The flow rate will be recorded during the test
- Eight background samples of clear water will be collected at evenly spaced intervals throughout the duration of the scour test
- Effluent samples will be collected with the grab sampling method

Table 3. Results of the preliminary scour test

samples	time	flowrate gal/min	temp °C	background g/min	effluent g/l	result %
start	14:00:00	119	9.8			
1	14:02:00		9.8	0.052	0.104	0.052
2	14:04:00		9.8		0.088	0.036
3	14:06:00	119	9.8	0.050	0.082	0.032
4	14:08:00		9.8		0.072	0.022
5	14:10:00		9.8	0.051	0.070	0.019
6	14:12:00	119	9.8		0.068	0.017
7	14:14:00		9.8	0.052	0.065	0.013
8	14:16:00		9.8		0.067	0.015
9	14:18:00	119	9.8	0.049	0.065	0.016
10	14:20:00		9.8		0.061	0.012
11	14:22:00		9.8	0.050	0.054	0.004
12	14:24:00	119	9.8		0.058	0.008
13	14:26:00		9.8	0.054	0.062	0.008

14	14:28:00		9.8		0.058	0.004
15	14:30:00	119	9.8	0.052	0.062	0.010
average		**7.4**	**9.8**	**0.051**	**0.069**	**0.018**
COV		0.030	0.000	0.030		

2.6 Quality Objectives and Criteria

PSD samples will be sent to a commercial laboratory. TSS samples will be analyzed in-house and will be observed by the third-party witness.

3 Performance Claims

The following performance claims shall be verified:

Total Suspended Solids (TSS) Removal Efficiency

- The removal efficiency of TSS should be > 80 %.

Maximum treatment flow Rate (MTFR)

- The maximum treatment flow rate (MTFR) for the system is 17,4 gal/min.

Maximum Storage Depth and Volume

- The maximum storage depth for sediment is 16.7 in. The maximum storage volume is 38 gal.

Wet Volume and Detention Time

- The wet volume was obtained by a tracer test and is 115 gal.

Effective Sedimentation Area

- The effective sedimentation area is 7.75 ft^2.

Effective Filtration Area

- The effective filtration area is 6.24 ft^2.

Sediment Mass Load Capacity

- The sediment mass load capacity will be 150 LBS

Maximum Allowable Inflow Drainage Area

- The maximum allowable inflow drainage area is 0.25 acres (1.000 m^2) for Hydrosystem 1000

These claims are valid for the Hydrosystem 1,000. For the larger system 1,500 or designs with a specific number of filter cartridges the claims will be given in the final report.

4 Supporting Documentation

"Copies of the laboratory test reports. including all collected and measured data; all data from performance evaluation test runs; spreadsheets containing original data from all performance test runs; all pertinent calculations; etc." will be provided in this section of the final testing report.

4.1 Removal Efficiency Testing

During the preliminary testing 10 test runs were completed in accordance with the NJDEP filter protocol. The first three runs were carried out at 39.6 gal/min (2.5 L/s), but the removal efficiency was not high enough. The target flowrate was then reduced to 17.4 gal/min (1.10 L/s) while the influent sediment concentration was always 200 mg/L. Three additional test runs were carried out at 17.4 gal/min (1.10 L/s) and 400 mg/L sediment concentration as the head loss during the first 10 test runs was not significantly lowered. The results can be seen in Table 4.

Table 4. Results of the pre-test

run no.	samples	date	time	flowrate	temp	background	dosing	influent	effluent	efficiency
				l/s	°C	g/min	g/min	g/l	g/l	%
1	start	23.11.16	14:15:00							
	1		14:27:00	2,24	12,0	0,002	24,580	0,183	0,062	66,1
	2		14:32:00	2,25	12,0			0,187	0,068	63,6
	3		14:37:00	2,21	12,0	0,002	25,340	0,191	0,048	74,9
	4		14:42:00	2,23	12,0			0,195	0,084	56,9
	5		14:47:00	2,23	12,2	0,002	26,540	0,198	0,062	68,7
	average			**2,23**	**12,0**	**0,002**	**25,487**	**0,191**	**0,065**	**66,0**
	COV			0,006	0,007	0,000		0,029		
2	start	23.11.16	15:15:00							
	1		15:27:00	2,21	12,2	0,003	24,240	0,183	0,064	65,0
	2		15:32:00	2,22	12,2			0,185	0,046	75,2
	3		15:37:00	2,26	12,2	0,003	25,450	0,188	0,064	65,9
	4		15:42:00	2,25	12,2			0,192	0,064	66,6
	5		15:47:00	2,25	12,2	0,003	26,450	0,196	0,074	62,2
	average			**2,24**	**12,2**	**0,003**	**25,380**	**0,189**	**0,062**	**67,0**
	COV			0,009	0,000	0,000		0,025		
3	start	23.11.16	16:11:00							
	1		16:23:00	2,23	12,2	0,002	24,540	0,183	0,065	64,6
	2		16:28:00	2,24	12,2			0,185	0,064	65,3
	3		16:33:00	2,21	12,2	0,002	24,650	0,186	0,065	65,0
	4		16:38:00	2,24	12,2			0,184	0,058	68,5
	5		16:43:00	2,25	12,2	0,002	24,650	0,183	0,061	66,6
	average			**2,23**	**12,2**	**0,002**	**24,613**	**0,184**	**0,063**	**66,0**
	COV			0,006	0,000	0,000		0,006		
4	start	29.11.16	14:00:00							
	1		14:12:00	1,24	12,0	0,001	16,890	0,225	0,034	84,9
	2		14:17:00	1,26	12,0			0,218	0,042	80,7
	3		14:22:00	1,25	12,0	0,001	15,760	0,210	0,042	80,0
	4		14:27:00	1,24	12,0			0,204	0,042	79,4
	5		14:32:00	1,25	12,0	0,001	14,800	0,197	0,042	78,7
	average			**1,25**	**12,0**	**0,001**	**15,817**	**0,211**	**0,040**	**80,7**
	COV			0,006	0,000	0,000		0,047		
5	start	29.11.16	16:00:00							
	1		16:12:00	1,11	12,0	0,002	14,607	0,219	0,036	83,6
	2		16:17:00	1,08	12,0			0,226	0,036	84,1
	3		16:22:00	1,06	12,0	0,002	14,850	0,233	0,042	82,0
	4		16:27:00	1,10	12,0			0,226	0,042	81,4
	5		16:32:00	1,12	12,0	0,002	14,690	0,219	0,042	80,8
	average			**1,09**	**12,0**	**0,002**	**14,716**	**0,225**	**0,040**	**82,4**
	COV			0,020	0,000	0,000		0,024		
6	start	08.12.16	09:38:00							
	1		09:59:00	1,10	10,5	0,002	13,260	0,201	0,050	75,1
	2		10:02:00	1,08	10,5			0,199	0,018	91,0
	3		10:05:00	1,12	10,5	0,002	13,260	0,197	0,030	84,8
	4		10:08:00	1,06	10,5			0,207	0,046	77,8
	5		10:11:00	1,05	10,5	0,002	13,670	0,217	0,020	90,8
	average			**1,08**	**10,5**	**0,002**	**13,397**	**0,204**	**0,033**	**83,9**
	COV			0,024	0,000	0,000		0,035		
7	start	08.12.16	10:25:00							
	1		10:46:00	1,07	10,5	0,003	13,260	0,207	0,046	77,7
	2		10:49:00	1,06	10,5			0,205	0,034	83,4
	3		10:52:00	1,10	10,5	0,003	13,450	0,204	0,036	82,3
	4		10:55:00	1,08	10,5			0,204	0,030	85,3
	5		10:58:00	1,08	10,5	0,003	13,230	0,204	0,028	86,3
	average			**1,08**	**10,5**	**0,003**	**13,313**	**0,205**	**0,035**	**83,0**
	COV			0,012	0,000	0,000		0,005		

run no.	samples	date	time	flowrate	temp	background	dosing	influent	effluent	efficiency
				l/s	°C	g/min	g/min	g/l	g/l	%
8	start	08.12.16	11:20:00							
	1		11:41:00	1,05	10,0	0,002	13,260	0,210	0,050	76,2
	2		11:44:00	1,10	10,0			0,205	0,038	81,4
	3		11:47:00	1,08	10,0	0,002	12,890	0,199	0,034	82,9
	4		11:50:00	1,06	10,0			0,202	0,038	81,2
	5		11:53:00	1,07	10,0	0,002	13,220	0,206	0,030	85,4
	average			**1,07**	**10,0**	**0,002**	**13,123**	**0,204**	**0,038**	**81,4**
	COV			0,016	0,000	0,000		0,019		
9	start	08.12.16	13:45:00							
	1		14:06:00	1,10	10,0	0,002	12,980	0,197	0,038	80,7
	2		14:09:00	1,05	10,0			0,196	0,014	92,9
	3		14:12:00	1,06	10,0	0,002	12,450	0,196	0,028	85,7
	4		14:15:00	1,10	10,0			0,204	0,032	84,3
	5		14:18:00	1,06	10,0	0,002	13,450	0,211	0,030	85,8
	average			**1,07**	**10,0**	**0,002**	**12,960**	**0,201**	**0,028**	**85,9**
	COV			0,020	0,000	0,000		0,030		
10	start	08.12.16	15:00:00							
	1		15:21:00	1,06	10,0	0,002	12,330	0,194	0,042	78,3
	2		15:24:00	1,04	10,0			0,195	0,028	85,6
	3		15:27:00	1,09	10,0	0,002	12,820	0,196	0,032	83,7
	4		15:30:00	1,10	10,0			0,199	0,034	82,9
	5		15:33:00	1,09	10,0	0,002	13,200	0,202	0,032	84,1
	average			**1,08**	**10,0**	**0,002**	**12,783**	**0,197**	**0,034**	**82,9**
	COV			0,021	0,000	0,000		0,015		
11	start	08.12.16	15:52:00							
	1		16:13:00	1,08	10,0	0,002	25,830	0,399	0,102	74,4
	2		16:23:00	1,09	10,0			0,409	0,086	79,0
	3		16:33:00	1,03	10,0	0,002	25,940	0,420	0,072	82,8
	4		16:43:00	1,09	10,0			0,403	0,092	77,1
	5		16:53:00	1,08	10,0	0,002	24,980	0,385	0,054	86,0
	average			**1,07**	**10,0**	**0,002**	**25,583**	**0,403**	**0,081**	**79,9**
	COV			0,021	0,000	0,000		0,028		
12	start	15.12.16	09:00:00							
	1		09:21:00	1,08	9,0	0,011	26,210	0,404	0,088	78,2
	2		09:31:00	1,10	9,0			0,396	0,082	79,3
	3		09:41:00	1,11	9,0	0,011	25,850	0,388	0,078	79,9
	4		09:51:00	1,05	9,0			0,398	0,072	81,9
	5		10:01:00	1,04	9,0	0,011	25,430	0,408	0,058	85,8
	average			**1,08**	**9,0**	**0,011**	**25,830**	**0,399**	**0,076**	**81,0**
	COV			0,025	0,000	0,000		0,017		
13	start	15.12.16	10:30:00							
	1		10:51:00	1,04	9,0	0,011	25,450	0,408	0,106	74,0
	2		10:54:00	1,03	9,0			0,412	0,086	79,1
	3		10:57:00	1,05	9,0	0,011	26,200	0,416	0,087	79,1
	4		11:00:00	1,10	9,0			0,416	0,046	88,9
	5		11:03:00	1,03	9,0	0,011	25,670	0,415	0,058	86,0
	average			**1,05**	**9,0**	**0,011**	**25,773**	**0,413**	**0,077**	**81,4**
	COV			0,025	0,000	0,000		0,008		

4.2 Sediment Mass Loading Capacity

During the tests about 23 LBS (10.6 kg) of sediment was used to charge the system. As altogether 165 LBS (75 kg) of TSS should be applied in the official tests longer test runs with 400 mg/l test sediment will be carried out. Figure 12 shows the sediment mass versus flow rates during the 13 test runs.

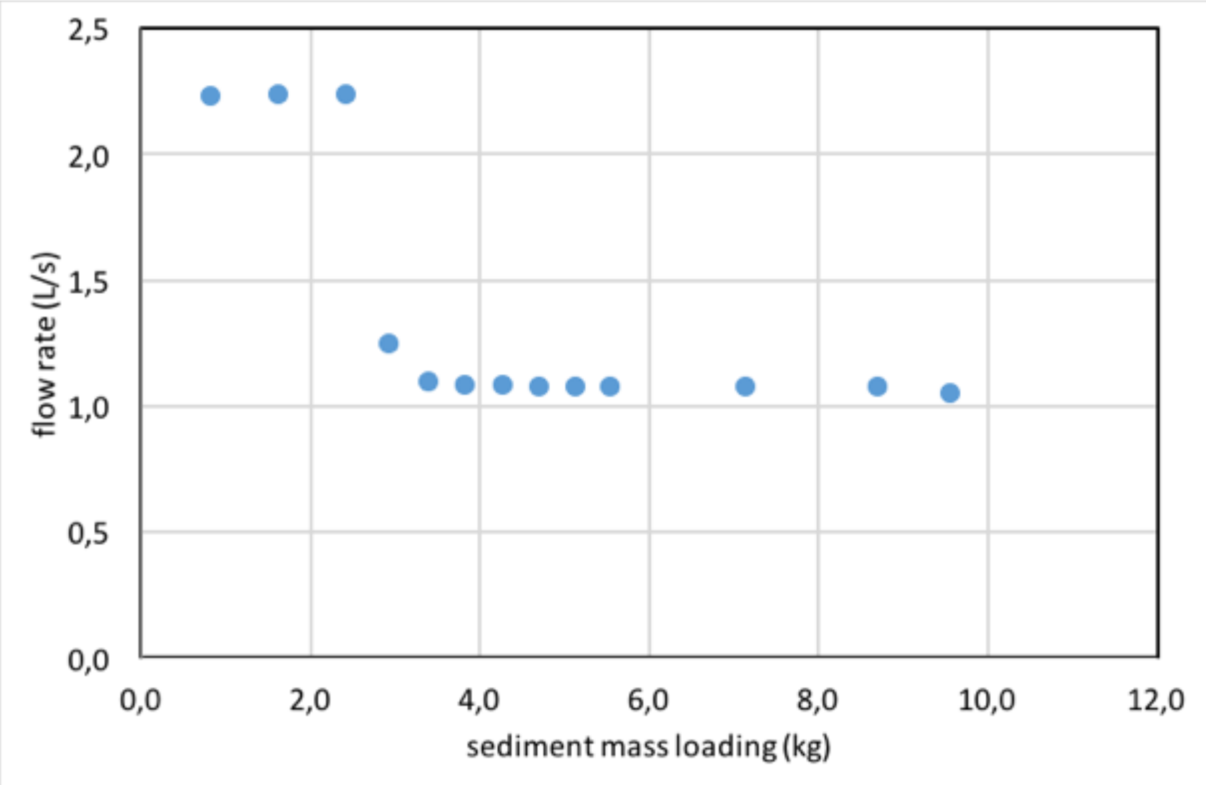


Figure 12. Sediment mass loading vs. flow rate

Figure 13 shows the mass loading versus the removal efficiency.

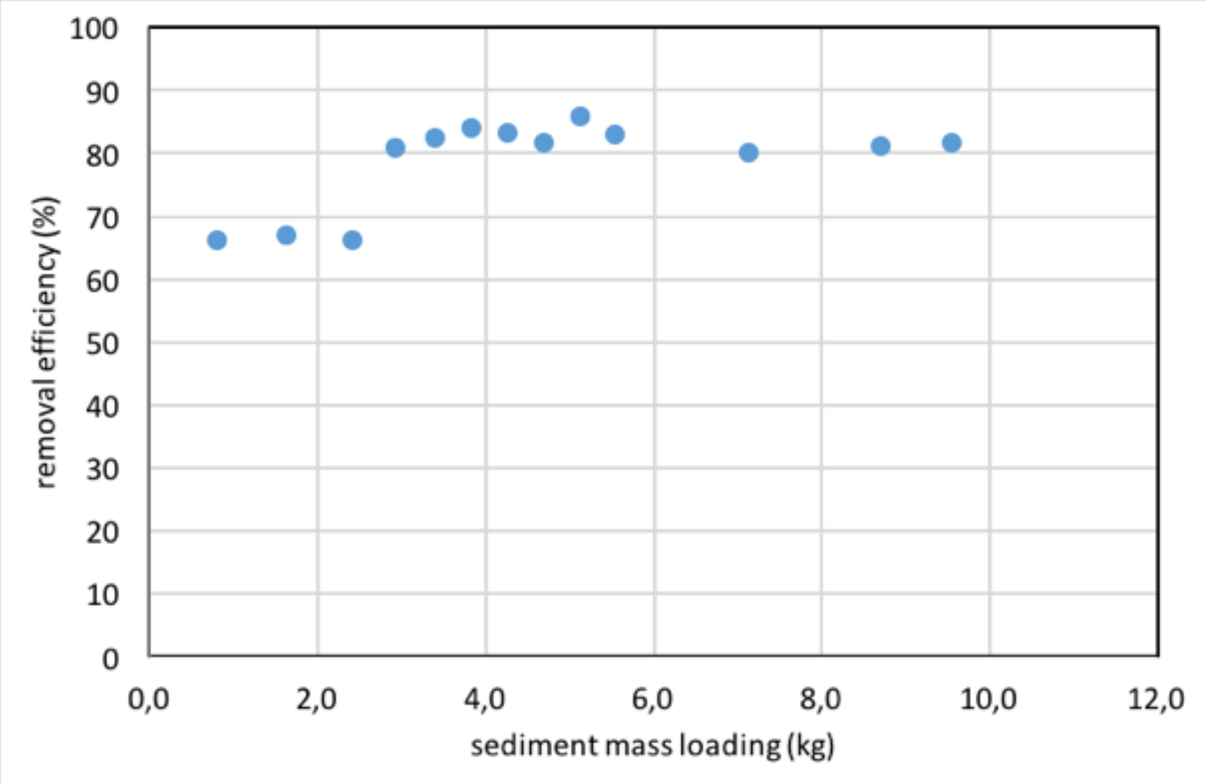


Figure 13. Sediment mass loading vs. removal efficiency

4.3 Filter Operating Head

Figure 10 shows the head loss. As expected, there was no change of the head loss during the tests. 90 % MTFR could not be reached. For 17.4 gal/min (1.1 L/s) the pressure head of the system is only 0.6 in (1.5 cm).

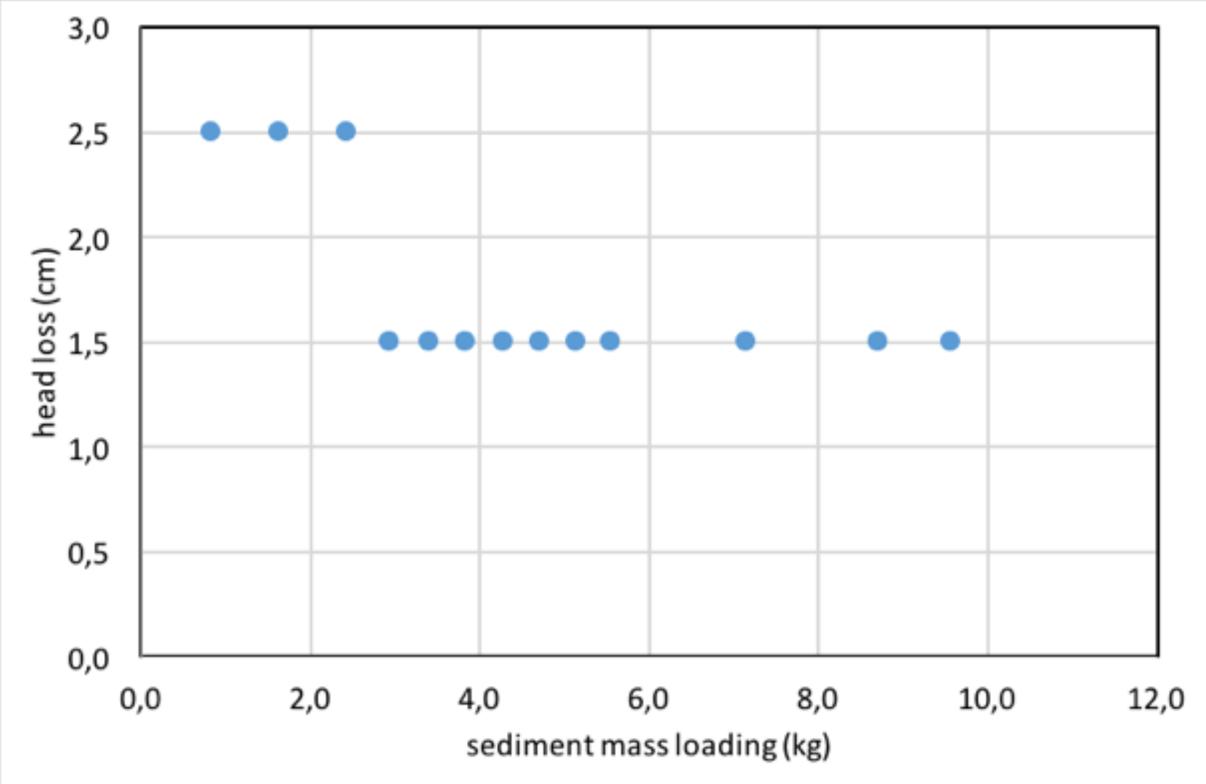


Figure 14. Sediment mass loading vs. head loss

5 Design Limitations

As more than 2,000 units of the Hydrosystem are sold in Europe, Asia and Australia the possibility of failure seems to be minimal. The system got a General Technical Approval by the Deutsches Institut für Bautechnik (DIBT) in 2010. This approval also contains TSS tests with similar requirements to the NJDEP protocol.

6 Maintenance

Because of the pollutants and harmful substances within the runoff, stormwater treatment systems have to be controlled and cleaned in regular intervals like all stormwater treatment facilities.
Therefore, the following maintenance is necessary for the Hydrosystem:

Inspections every year

- In intervals between 1 and 5 years the silt trap under the filter shall be emptied and the filters have to be flushed or exchanged - With street areas the interval is closer to two years, with roof areas typically five years
- These intervals can vary according to atypical low or high solids in the stormwater runoff. This can be observed in the first few operating years. An obvious indication that high solids loads are present is a frequent working of the overflow, generating turbid effluent water.

Necessary tools and materials:

- Suction and flushing vehicle or submersible mud pump with pipes
- Power generator if there is no power supply available
- High pressure cleaner
- Rescue tripod with 2 winches (for rescue of people and filter exchange)
- PPE suitable for confined space entry
- Gas detector
- Box for filter cartridges

Please note:

- The water pumped out from the Hydrosystem sump can only be discharged into a sanitary sewer, a combined sewer or a solids disposal area. It must not be released into waterways, a storm sewer, a cistern or in an underground French drain.
- If there is a possibility you can use a mobile water treatment system. The water treated can be discharged into waters or stormwater sewer.

Preparations for maintenance

1. Position the rescue tripod above the opened shaft

2. Check the atmosphere in the shaft with the gas detector and observe it constantly

3. With metal roof systems take out the sample of water above the filter elements

4. Put on the rescue dressing

5. Hook it into the rescue winch

6. Go down into the shaft and position on the filter elements

Preparations for filter demounting

1. Pull the overflow out of the bushing and lift it out of the shaft

2. Disconnect the screw nut on the T-piece and take it off

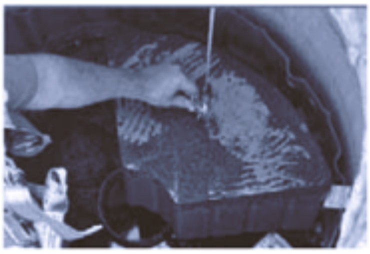
3. Take out the T-piece completely and lift it out

4. Pull the locking device on both sides outwards

5. Take out the locking device and lift it out of the shaft

6. These three mounting parts are now beside the shaft

Taking out the filter elements



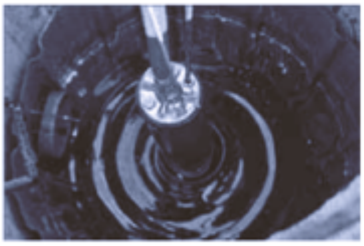
1. Hook the wire rope into the filter ear and pull out the filter completely out of the shaft

2. Put the filter in the provided box

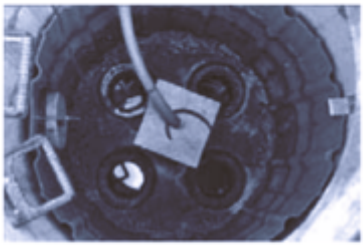
3. Put the other filter elements into the box

Flushing the inner shaft

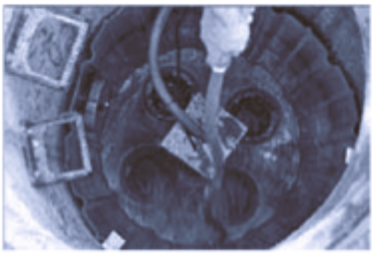
1. Lower the pump through the outlet tube into the shaft



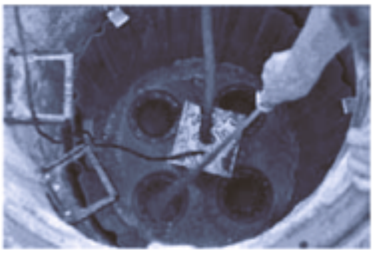
2. Turn on the pump and pump out the water, please observe the specifications for the draining



3. Pump out the water until below the intermediate level flushing the filter



4. Flush the inner of the shaft thouroughly with water



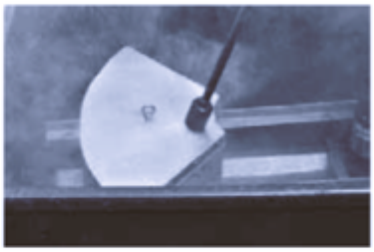
5. Flush the sealings for the filter elements thoroughly

6. When the shaft is clean, the pump can be pulled out

Flushing the filter elements

1. With the small maintenance only flush the filter elements from outside, outherwise you have to install new ones

2. Flush the filter from inside so that the perforated plate will be clean



3. Finally flush the filter element thoroughly from above

Preparing the installation of the filter elements

1. This is how the shaft looks now from inside

2. All is prepared for the installation of the filter

3. If the filters will be exchanged, the old filters are packed in a box

Insert filter and fastening of the accessory

1. Let down the filter elements into the shaft and put them into the sealings

2. Start with the two filters beneath the outlet then fasten the other ones

3. Insert T-piece (oil barrier) after all four filters have been installed

4. Tighten the screw nut on the oil barrier

5. Put in the locking device until it is shut

6. Put the overflow on the middle tube

7 References

ASTM D422-63. Standard Test Method for Particle Size Analysis of Soils

ASTM D3977-97. Standard Test Method for Determining Concentrations in Water Samples

New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device." dated January 25, 2013

Appendix A: Qualification of the third party observer

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RESUME

Education/occupational history

1981 - 1989	Studies at the Technical University of Karlsruhe, certificate diploma, discipline civil engineering, specialized in water engineering and sanitary environmental engineering
1989 - 1997	Academic assistant at the Institute of Urban Water Management at the University of Kaiserslautern.
since 1994 to present	Author and mentor at the University of Koblenz/Landau in the distance study „Applied Environmental Science“
since 1998 to present	Freelance work at different engineering companies, industrial enterprises, the University of Kaiserslautern, the German TÜV (Technical Supervisory Association)
since 2010 to present	Academic assistant at the Institute of Urban Water Management at the Frankfurt University of Applied Science
2014	Examination for a doctorate at the University of Kaiserslautern

Professional field of activities:

Planning activities in fields of

- Public water supply
- General emergency plans of water supply
- water treatment (public water, process water, wastewater, industrial waste water, water from public swimming pools)
- Stormwater treatment and infiltration

Research and development activities in the field of:

- Stormwater treatment in local (filter-)systems and novel types of facilities
- Development of certification procedures for run off treatment devices
- Organic harmful substances in wastewater and sewage sludge
- Sewage sludge treatment

Proceedings and lectures in the field of stormwater treatment

Dierschke, M. (2014): Aufkommen und Verbleib von feinen Feststoffen in Verkehrsflächenabflüssen. ***(Arise and fate of fine suspended solids in street run offs)***. WASSER UND ABFALL. 9/2014. S. 24 – 29

Dierschke, M. (2014): Methodischer Ansatz zur Quantifizierung von Feinpartikeln (PM63) in Niederschlagsabflüssen in Abhängigkeit von der Herkunftsfläche. *(**Methodical approach for quantifying of fine particles (PM63) in rainfall runoffs depending on the surface of origin**)* Dissertation im Fachbereich Bauingenieurwesen der Technischen Universität Kaiserslautern, Kaiserslautern, Mai 2014. https://kluedo.ub.uni-kl.de/frontdoor/index/index/docId/3808

Huber, M; Welker, A.; Dierschke, M.; Drewes, J.E.; Helmreich, B. (2014): Ein neues Laborverfahren zur Ermittlung von Standzeiten dezentraler Anlagen zur Behandlung von Verkehrsflächenabflüssen. ***(A new method in laboratory to determine the lifetime of decentralized treatment devices for street run offs)***. gwf Wasser Abwasser, (155), Nr. 5, S. 630 -638

Dierschke, M; Welker, A. (2013): Feine Feststoffe (PM63) in Dachabflüssen. ***(Fine suspended solids (PM63) in roof run offs)***. gwf Wasser Abwasser, (154), Nr. 11, S. 1242-1249

Dierkes, C.; Welker, A.; Dierschke, M. (2013): ***Development of testing procedures for certification of decentralized storm water treatment facilities – Results from laboratory investigations***. Proceedings Novatech 2013, 8th International Conference: Plannings and Technologies for Sustainable Urban Watermanagement, Lyon, France 2013

Welker A.; Dierschke, M. (2013): Dezentrale Niederschlagswasserbehandlung – Status Quo und Neuere Entwicklungen. ***(Decentralized stormwater treatment devices – status quo and trends)***. Proceedings der 12. Regenwassertage der DWA, Freiburg im Breisgau

Dierschke, M.; Welker A. (2012): Dezentrale Behandlung von Niederschlagsabflüssen. ***(Decentralized treatment of stormwater).*** Seminar an der FH Frankfurt. KA Korrespondenz Abwasser, Abfall, Nr. 3, S. 186 - 188

Welker, A; Dierschke, M. (2012): Dezentrale Niederschlagswasserbehandlung - status quo und neue Entwicklungen. ***(Decentralized stormwater treatment devices – status quo and trends)***. Proceedings der 11. Regenwassertage der DWA, Berlin

Uhl, M.; Maus, C.; Welker, A.; Dierschke, M. (2011): Prüfverfahren für Anlagen zur dezentralen Niederschlagswasserbehandlung. (***Test procedures for decentralized treatment devices).*** 12. Kölner Kanaltage 2011, Köln

Dierschke, M. (2011): Stand der Prüfverfahren von dezentralen Behandlungsanlagen. ***(Status on test procedures for decentralized treatment devices).*** Seminar: Dezentrale Behandlung von Niederschlagsabflüssen 12. Mai 2011 an der FH Frankfurt

Welker A.; Dierschke, M. (2011): Neuere Entwicklungen bei der dezentralen Niederschlagswasser-behandlung. ***(Trends on decentralized stormwater treatment).*** 10. DWA Regenwassertage zur Regenwasserversickerung, -nutzung, -bewirtschaftung, -behandlung, 10. – 11. Mai 2011 Bad Soden/Frankfurt

Welker A.; Dierschke, M. (2010): Systeme und Anlagen zur dezentralen Regenwasserbehandlung. ***(Systems and Devices for decentralized stormwater treatment)***. Proceedings "11. Kölner Kanal und Kläranlagen Kolloquium", Band 14, S. 3-1 - 3-9

Dierschke, M.; Welker A. und Dierkes, C. (2010): ***Selection of a Reference Material for the testing of Decentralized Stormwater Treatment Facilities***. Novatech 2010, 7th International Conference: Sustainable techniques and strategies in urban waste water, 27. Juni - 1. Juli 2010, Lyon, France

Welker, A. und Dierschke, M. (2009): Aufkommen von Schwermetallen in Niederschlagsabflüssen von Dachflächen als Basis für die Festlegung von Stoffkonzentrationen für Prüfverfahren von Behandlungsanlagen ***(Arise of heavy metals in roof run offs as base on the requirements of concentrations for certification approvals on treatment devices).*** gwf Wasser Abwasser (150) Nr. 7-8, S. 595 - 605