Supplementary Information
to

Heavy metal leaching from stormwater control measures – Insights of field and lab prestressed media and road-deposited sediments

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Tables:

Table S1. *Conditions and heavy metal retention of the filter media in the lab scale prestressing procedure.*

SCM	Catch-ment area	Full-scale filter surface	Model Scale Factor	Influent Volume	$pH_{effluent}$	Zn retention	Cu retention
Unit	m²	m²	-	L	-	%	%
S	830[a]	0.41 [a]	1:82	117.4	7.4	91.7	>97.3
D	165	1.55	1:55	35	8.3	>99.3	>97.3
V	473	0.63	1:80	68.6	9.9	95.5	>97.6

[a] connected catchment and filter surface area per installed filter cartridges

Table S2. *Conditions and heavy metal retention of the filter media in the lab scale prestressing procedure.*

Eluent	Chemical	Molecular weight [g/mol]	Concentration [mg/L]
SRR	$ZnSO_4 \cdot\cdot 7H_2O$	287.5	0.44[a] (0.050 Cu)
	$CuSO_4 \cdot\cdot 5H_2O$	249.7	0.196[a] (0.100 Zn)
	$MgSO_4 \cdot\cdot 7H_2O$	246.5	55.0[a]
	KCl	74.6	25.0[a]
	KNO_3	101.1	90.0[a]
	$NaNO_3$	85.0	90.0[a]
	$CaCl_2$	111	200[a]
	$NaHCO_3$	84.0	97.3[b]
SRR + NaCl	Identical as SRR		
	NaCl	58.4	10,000[c]

[a] (Barrett et al., 2014)
b (Rommel et al., 2020)
c (Huber et al., 2016)

Table S3. *Heavy metal contents (pseudo-total after Aqua Regia Digestion) and chemical properties of the blank filter media; heavy metal contents and loss on ignition (LOI) refer to dry matter; sampling S field blank was not possible; data published previously in Rommel et al. (2021).*

Parameter	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**	**LOI**
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%
D Field Blank	2.5[a]	2.5[a]	1.0[a]	81.0	43.3	0.5
D Lab Blank	13.7	2.5[a]	10.0	5.0[a]	13.7	0.4
S Lab Blank	2.5[a]	2.5[a]	36.4	5.0[a]	53.6	56.3
V Field Blank	12.2	2.5[a]	5.2	5.0[a]	17.5	5.9
V Lab Blank	2.5[a]	2.5[a]	3.9	45.5	34.9	5.7

[a] Value below LOQ, substituted by 0.5 · LOQ.

Table S4. *Raw data of the quiescent column leaching test. FM = Filter Media; FC = Filter Cake.*

SCM	**Pre-stressing**	**Material**	**Eluent**	**Timestep**	**pH**	**EC**	**DOC**	**Cu**	**Ni**	**Zn**
Unit				h	-	µs/cm		mg/L		
D	Lab	FM	4	SRR	7.87	874	0.901	<0.01		0.136
D	Lab	FM	4	SRR	8.04	862	1.32	0.014		0.144
D	Lab	FM	48	SRR	7.96	882	0.828	0.013		0.185
D	Lab	FM	48	SRR	7.96	851	0.568	0.012		0.223
D	Lab	FM	168	SRR	8.02	885	1.29	0.016		0.227
D	Lab	FM	168	SRR	8.06	885	0.534	0.015		0.215
D	Lab	FM	4	SRR_NaCl	8.14	18,440	0.783	0.010		0.271
D	Lab	FM	4	SRR_NaCl	8.2	18,470	0.798	0.011		0.365
D	Lab	FM	48	SRR_NaCl	8.11	18,570	1.29	<0.01		0.399
D	Lab	FM	48	SRR_NaCl	8.22	18,470	0.873	0.011		0.324
D	Lab	FM	168	SRR_NaCl	8.19	18,350	1.29	0.010		0.339
D	Lab	FM	168	SRR_NaCl	8.18	18,390	1.39	0.010		0.288
V	Lab	FM	4	SRR	8.37	841	2.78	0.011		0.016
V	Lab	FM	4	SRR	8.34	840	1.95	0.012		0.011

V	Lab	FM	48	SRR	8.23	847	1.94	<0.01		0.009
V	Lab	FM	48	SRR	8.35	850	2.32	<0.01		0.007
V	Lab	FM	168	SRR	8.36	848	1.88	<0.01		0.009
V	Lab	FM	168	SRR	8.29	850	2.1	<0.01		0.007
V	Lab	FM	4	SRR_NaCl	6.9	18,100	0.999	0.011		1.708
V	Lab	FM	4	SRR_NaCl	6.9	17,300	0.89	0.014		1.335
V	Lab	FM	48	SRR_NaCl	6	16,900	1.17	0.064		2.451
V	Lab	FM	48	SRR_NaCl	6.3	17,140	0.751	0.013		2.168
V	Lab	FM	168	SRR_NaCl	6.5	17,310	0.728	0.008		2.704
V	Lab	FM	168	SRR_NaCl	6.8	17,800	0.796	0.009		2.361
S	Lab	FM	4	SRR	8.18	1,086	4.98	0.030		0.040
S	Lab	FM	4	SRR	8.28	1,077	4.9	0.029		0.029
S	Lab	FM	48	SRR	8.2	1,093	1.56	0.028		0.025
S	Lab	FM	48	SRR	8.27	1,062	1.5	0.027		0.015
S	Lab	FM	168	SRR	8.27	1,077	1.62	0.027		0.017
S	Lab	FM	168	SRR	8.24	1,076	1.32	0.027		0.017
S	Lab	FM	4	SRR_NaCl	7.79	17,300	6.82	0.012		0.182
S	Lab	FM	4	SRR_NaCl	7.87	17,730	5.58	0.017		0.185
S	Lab	FM	48	SRR_NaCl	8.12	17,620	2.83	0.012		0.077
S	Lab	FM	48	SRR_NaCl	8.14	17,470	2.09	0.014		0.076
S	Lab	FM	168	SRR_NaCl	7.99	17,190	1.69	0.011		0.067
S	Lab	FM	168	SRR_NaCl	8.07	17,550	1.69	0.011		0.057
D	Field	FM	4	SRR	7.88	1,387	21.3	0.059	<0.01	0.088
D	Field	FM	4	SRR	7.87	1,333	18.7	0.044	<0.01	0.066
D	Field	FM	48	SRR	7.85	1,460	23.3	0.041	<0.01	0.108
D	Field	FM	48	SRR	7.82	1,417	22	0.057	<0.01	0.133
D	Field	FM	168	SRR	7.69	1,346	19.1	0.053	<0.01	0.132
D	Field	FM	168	SRR	7.71	1,426	22.5	0.040	<0.01	0.099
D	Field	FM	4	SRR_NaCl	7.83	18,710	22	0.071	0.016	0.211
D	Field	FM	4	SRR_NaCl	7.84	18,720	22.7	0.074	0.017	0.208

D	Field	FM	48	SRR_NaCl	7.83	18,730	22	0.039	0.011	0.169
D	Field	FM	48	SRR_NaCl	7.89	18,750	22.1	0.063	0.016	0.244
D	Field	FM	168	SRR_NaCl	7.7	18,700	21.9	0.063	0.016	0.283
D	Field	FM	168	SRR_NaCl	7.65	18,710	24.6	0.072	0.019	0.352
V	Field	FM	4	SRR	7.98	1,403	25	0.043	<0.01	0.012
V	Field	FM	4	SRR	7.98	1,355	22.2	0.037	<0.01	0.009
V	Field	FM	48	SRR	8.01	1,399	24.2	0.038	<0.01	0.017
V	Field	FM	48	SRR	8.02	1,386	22.7	0.029	<0.01	0.012
V	Field	FM	168	SRR	7.93	1,552	27.8	0.061	<0.01	0.044
V	Field	FM	168	SRR	7.97	1,484	25.5	0.050	<0.01	0.033
V	Field	FM	4	SRR_NaCl	7.63	18,500	22.5	0.094	0.073	0.277
V	Field	FM	4	SRR_NaCl	7.6	18,480	7.25	0.026	0.020	0.068
V	Field	FM	48	SRR_NaCl	7.62	18,550	13	0.042	0.050	0.293
V	Field	FM	48	SRR_NaCl	7.55	18,450	18.2	0.058	0.066	0.283
V	Field	FM	168	SRR_NaCl	7.48	18,500	16.2	0.049	0.068	0.336
V	Field	FM	168	SRR_NaCl	7.41	18,580	16.2	0.048	0.069	0.334
S	Field	FM	4	SRR	8.06	1,222	4.92	<0.01	<0.01	0.012
S	Field	FM	4	SRR	8.01	1,342	13.1	0.018	<0.01	0.008
S	Field	FM	48	SRR	8.04	1,445	8.93	0.018	<0.01	0.007
S	Field	FM	48	SRR	8.03	1,242	7.04	0.015	<0.01	0.005
S	Field	FM	168	SRR	7.97	1,304	5.51	0.016	<0.01	0.009
S	Field	FM	168	SRR	8.04	1,257	2.19	<0.01	<0.01	<0.02
S	Field	FM	4	SRR_NaCl	7.93	17,510	10.6	0.011	0.026	0.012
S	Field	FM	4	SRR_NaCl	7.82	17,450	7.71	<0.01	0.020	0.029
S	Field	FM	48	SRR_NaCl	7.86	17,270	3.69	<0.01	0.015	0.030
S	Field	FM	48	SRR_NaCl	7.84	17,430	17.6	0.012	0.028	0.042
S	Field	FM	168	SRR_NaCl	7.84	17,060	7.41	0.013	0.027	0.040
S	Field	FM	168	SRR_NaCl	7.85	17,760	5.92	0.011	0.030	0.036
D	Field	FC	4	SRR	7.77	2,540	83.4	0.275	0.023	0.487
D	Field	FC	4	SRR	7.7	2,510	79.6	0.266	0.022	0.490

D	Field	FC	48	SRR	7.74	2,600	95.1	0.195	0.023	0.552
D	Field	FC	48	SRR	7.7	2,620	94.8	0.200	0.023	0.525
D	Field	FC	168	SRR	7.99	2,420	85.7	0.170	0.021	0.359
D	Field	FC	168	SRR	7.84	2,370	84	0.107	0.014	0.257
D	Field	FC	4	SRR_NaCl	7.54	19,270	94.5	0.306	0.048	0.973
D	Field	FC	4	SRR_NaCl	7.55	20,100	109	0.330	0.055	1.130
D	Field	FC	48	SRR_NaCl	7.55	19,680	107	0.232	0.055	1.285
D	Field	FC	48	SRR_NaCl	7.52	19,670	104	0.227	0.053	1.277
D	Field	FC	168	SRR_NaCl	7.71	19,440	106	0.203	0.046	0.946
D	Field	FC	168	SRR_NaCl	7.6	19,470	105	0.201	0.048	0.996

Table S5. Raw data of shaken batch extraction test (DIN 19529). FM = Filter Media; FC = Filter Cake.

SCM	**Pre-stressing**	**Material**	**Eluent**	**Timestep**	**pH**	**EC**	**DOC**	**Cu**	**Ni**	**Zn**
Unit				h	-	µs/cm		mg/L		
D	Lab	FM	24	SRR	8.02	980	1.21	0.016		0.252
D	Lab	FM	24	SRR	8.07	970	0.9	0.016		0.271
D	Lab	FM	24	SRR_NaCl	8.13	18,290	0.99	<0.01		0.276
D	Lab	FM	24	SRR_NaCl	8.03	18,260	1.02	<0.01		0.289
D	Lab	FM	24	DI	8.41	259	0.9	<0.01		0.030
D	Lab	FM	24	DI	8.53	267	1.21	<0.01		0.024
D	Field	FM	24	SRR	7.84	1,393	33.2	0.119	0.010	0.109
D	Field	FM	24	SRR	7.82	1,385	33.5	0.120	0.010	0.100
D	Field	FM	24	SRR_NaCl	7.73	18,890	41	0.139	0.018	0.242
D	Field	FM	24	SRR_NaCl	7.71	18,690	40.9	0.143	0.017	0.257
D	Field	FM	24	DI	8.05	648	36.8	0.137	<0.01	0.071
D	Field	FM	24	DI	7.91	690	43.8	0.139	<0.01	0.080

Sequential extraction procedure - method:

The three-step optimized BCR® SEP (Rauret et al., 1999) was used to identify the mobile fraction. 80 mL PP centrifuge tubes (Herolab GmbH, Germany) were used for the extraction, and further laboratory-ware was made of borosilicate glass, polypropylene (PP), or Polytetrafluoroethylene (PTFE), as required. The labware was cleaned with 4 mol/L HNO3 and agitated for minimum 16 h in an end-over-end shaker. The reagents were mixed according to Rauret et al. (1999). The centrifuge tubes were filled with 1 ± 0.03 g of sample and filled with either 40 mL in Step 1/2 or 50 mL in Step 3 with the reagent solution. The reagent solution was 0.11 mol L−1 acetic acid in Step 1, 0.5 mol L−1 hydroxylamine hydrochloride for Step 2, and 1.0 mol L−1 ammonium acetate in Step 3. Subsequently, the samples were shaken for 16 h in a mechanical end-over-end shaker with a speed of 30 ± 5 rpm at a room temperature of 22 ± 3°C. Step 3 differs from the other steps by its hydrogen peroxide digestion with 20 mL H_2O_2 in a water bath at 85 ± 2 °C before adding the reagent and shaking. After the 16 h shaking, the solids were separated from the supernatant by centrifugation for 20 min at 3000 g. After the first and second extraction steps, the residues were washed with 20 mL ultrapure water and shaken. The supernatant was discarded after separation by centrifugation, as described before. An additional aqua regia digestion of the solid residual evaluated the residual fraction.

Figures:

Figure S1: Vertical profile of the filter substratum channel of SCM-D with the sorptive filter media

(carbonate sand, 0-15 cm) and the accumulated filter cake (ca. 15-19 cm)

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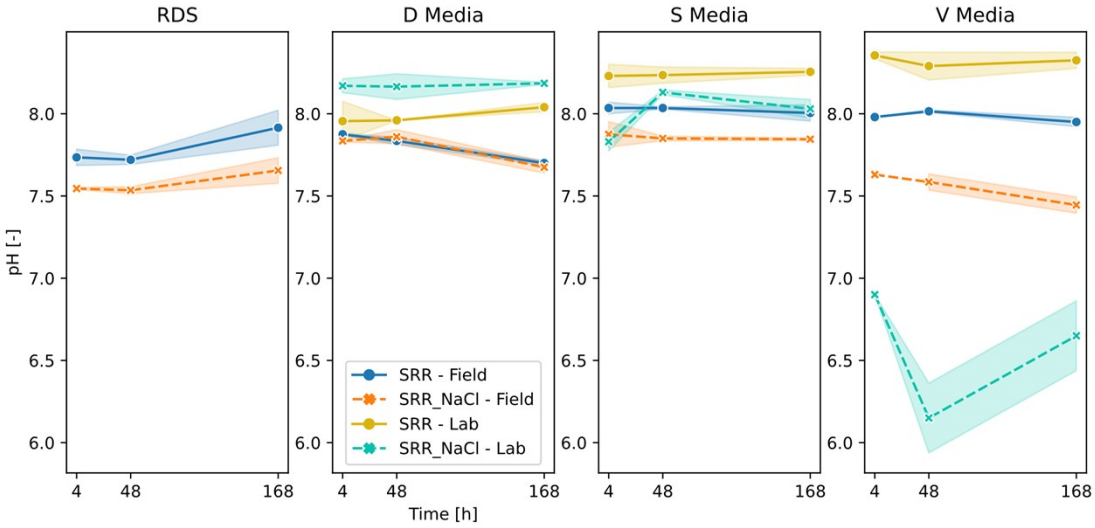

Figure S2: Time series of the mean pH values in the leachates of the tested media; standart deviation is represented by the shaded area

50

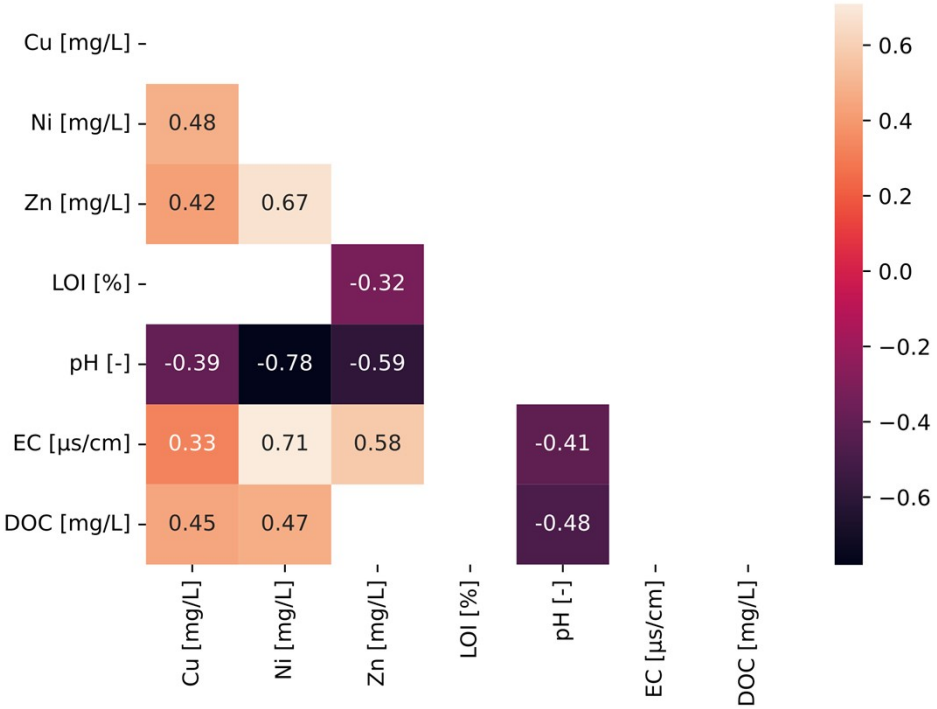

Figure S3: Correlation matrix with Spearman's correlation coefficient for seven parameters displayed

are significant ($p < 0.05$) correlation coefficients higher than ± 0.3.

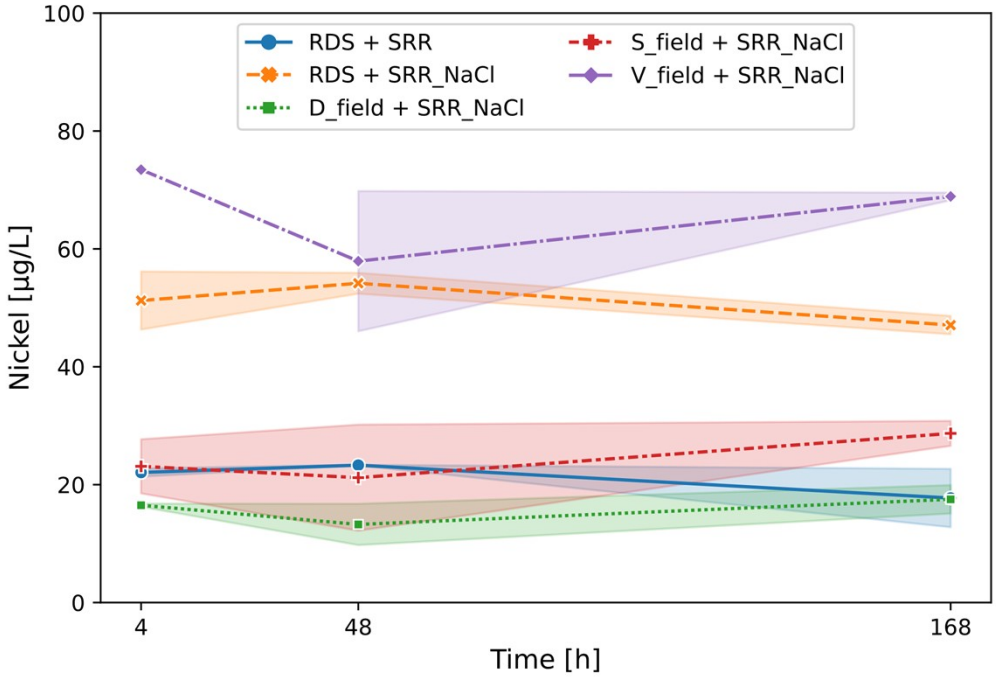

Figure S4: Time series of the mean dissolved Ni concentrations in the leachates of the field filter media; standart deviation is represented by the shaded area

Literatur:

Barrett, M., Katz, L., Taylor, S., Sansalone, J., Stevenson, M., 2014. Measuring and Removing Dissolved Metals from Stormwater in Highly Urbanized Areas. Transportation Research Board, Washington, D.C. https://doi.org/10.17226/22389

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Rauret, G., López-Sánchez, J.F., Sahuquillo, A., Rubio, R., Davidson, C., Ure, A., Quevauviller, P., 1999. Improvement of the BCR three step sequential extraction procedure prior to the certification of new sediment and soil reference materials. Journal of Environmental Monitoring 1, 57–61. https://doi.org/10.1039/A807854H

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