









Separation of microplastics in road runoff

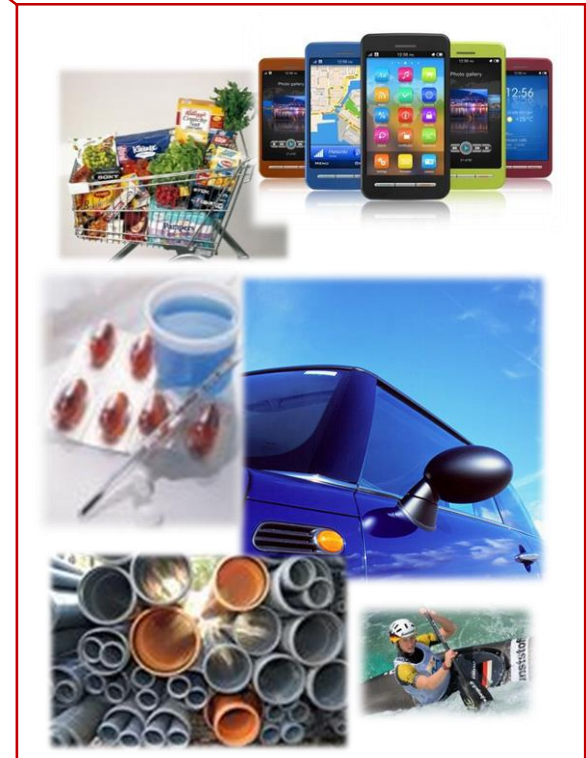
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- Development of wastewater disposal schemes for rural areas
 - greywater treatment
 - decentralized waste water treatment
 - ecological sanitation)
- Storm water management
- Optimisation of WWTP operation and processes; optimizing of energy use; improvement of sludge treatment
- Advanced wastewater treatment
 - filtration, biofiltration, wastewater disinfection
 - Microplastics
- Treatment of industrial wastewater (especially food industry, paper industry, laundry)
- Reduction of smell and corrosion in sewerage system

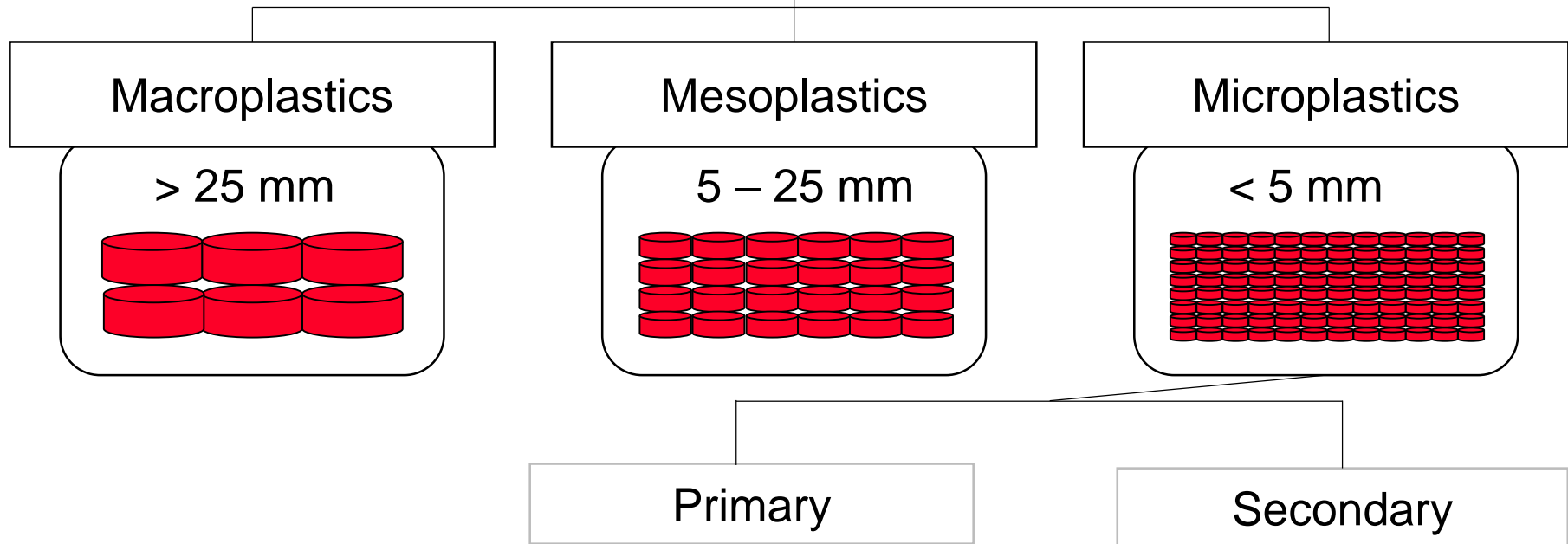
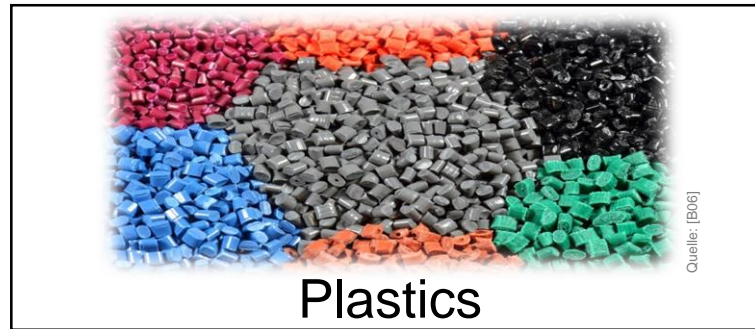
Microplastics

Sort	Denotation	Density [g/cm ³]	% of the production volume
Polystyrene		1.05	6
Polyethylen-terephthalat		1.37	7
high-density Polyethylen		0.94	17
Polyvinyl chloride		1.38	19
low-density Polyethylen		0.91– 0.93	21
Polypropylene		0.83– 0.85	24



Quelle:
[Bild06]

Sizes of Microplastics



classification: 5000 µm, 1000 µm, 500 µm, 100 µm, 50 µm, 10 µm

Optimized materials and processes for the separation of microplastic from the water cycle -OEMP

● Project goals

- Development of innovative restraint systems
- In-situ experiments of innovative materials and installation engineering
- Retention and separation of microplastic from the effluent of wastewater treatment plants, combined sewer overflows and street drainage

● Project management

- Gebrüder Kufferath AG (GKD) and Depart. of Urban water management, TU Berlin

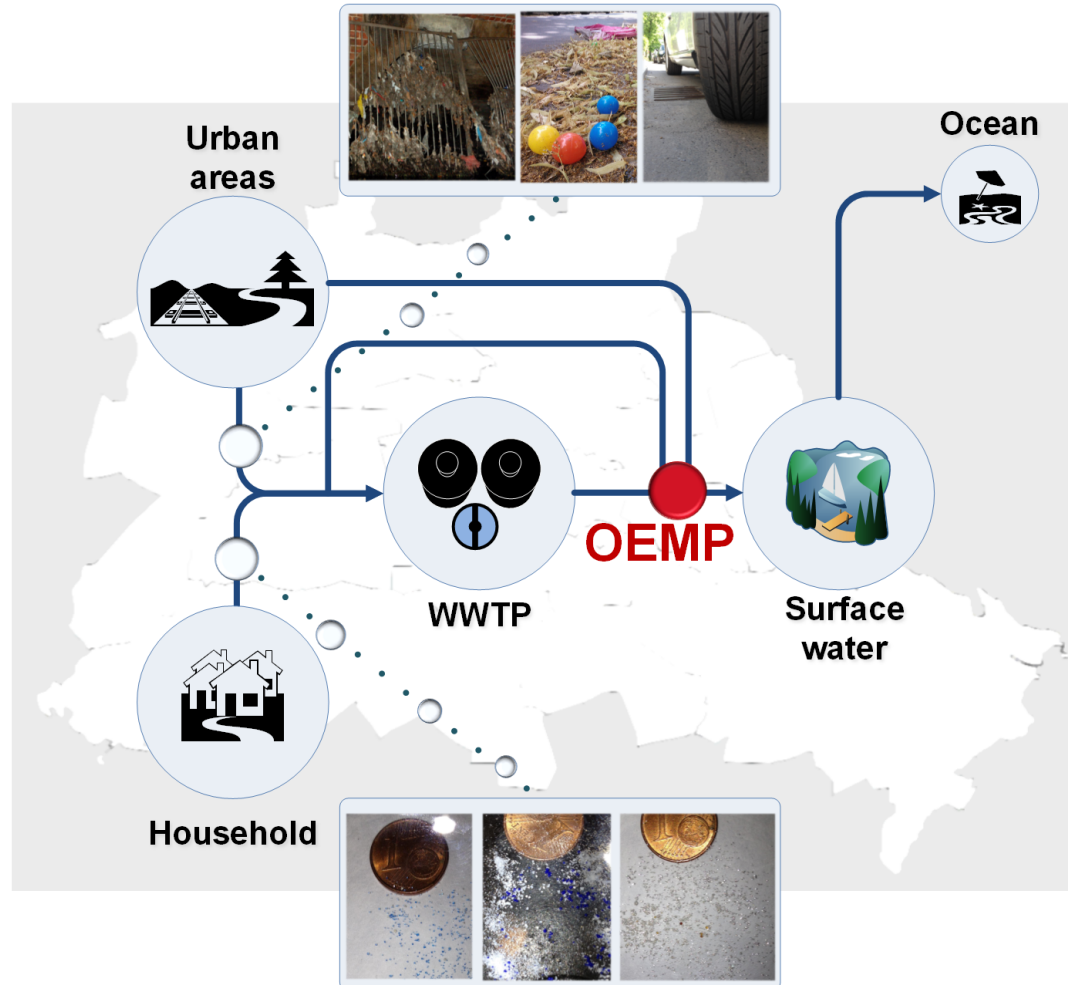
● Project duration

- 01.04.2016 - 31.03.2018

GEFÖRDERT VOM

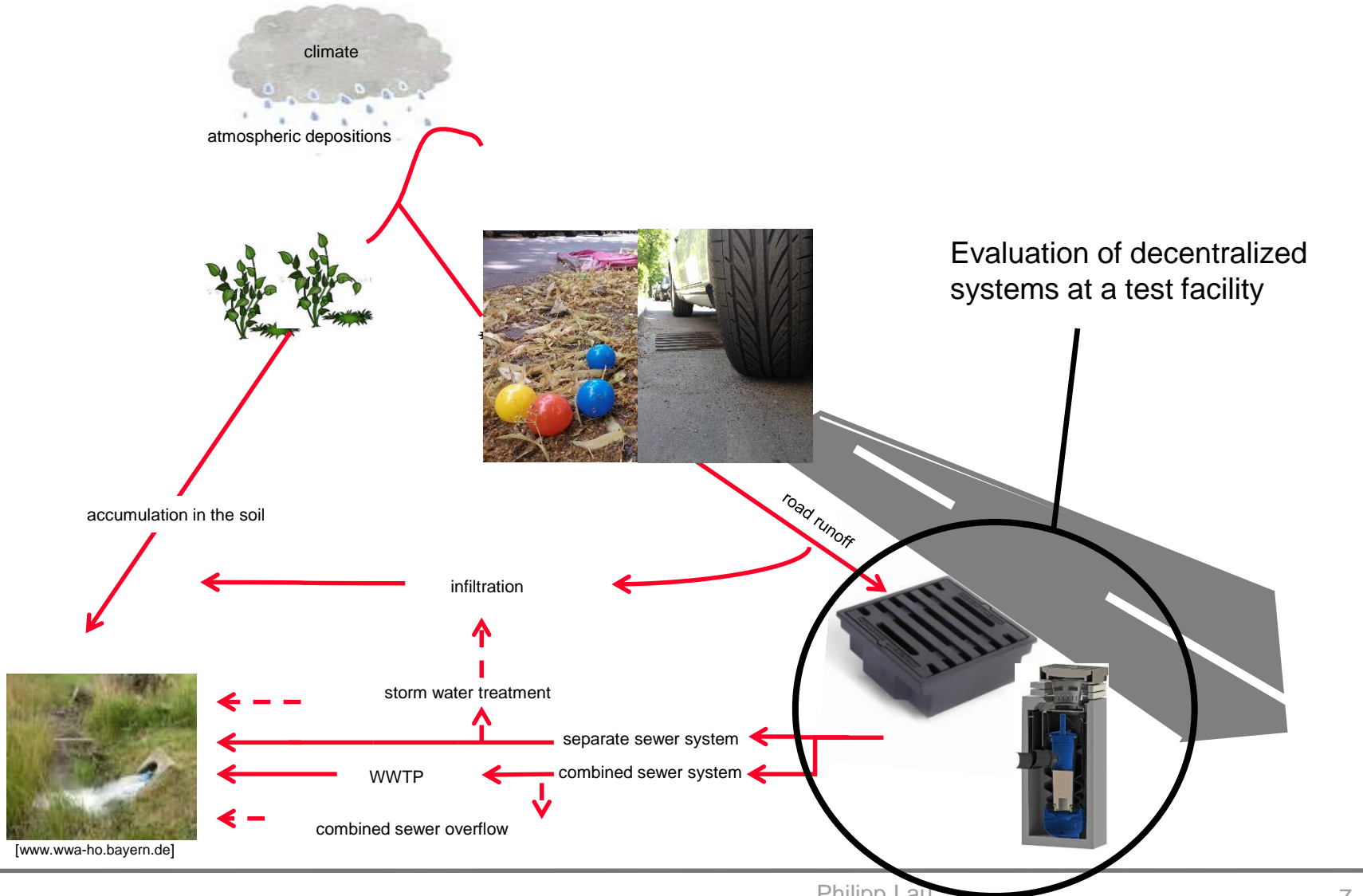


(Micro)Plastic in the environment



Picture
Source:
[Pic03],

Microplastic from tire wears



[www.wwa-ho.bayern.de]

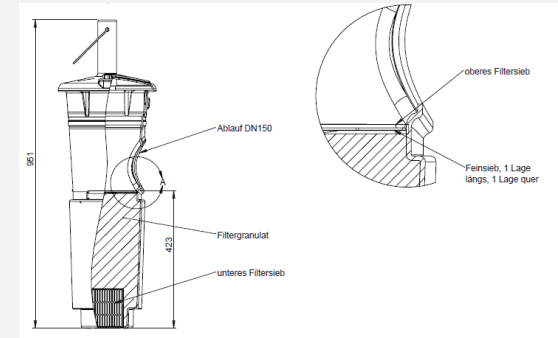
Decentralized systems

Aim: separation limit 100 μm

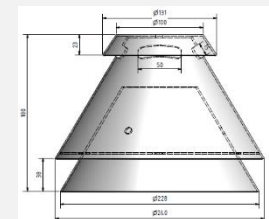
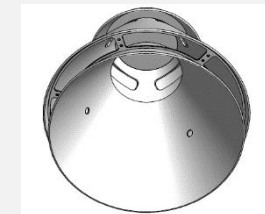
- BUDAVICI Typ-N/ MeierGuss
 - Optimized effluent of the filter cartridge
 - Pore size 300 μm
- INNOLET®-G, Funke
 - Optimized overflow
 - Pore size 315 μm
 - Stream diversion



MeierGuss Sales & Logistics GmbH

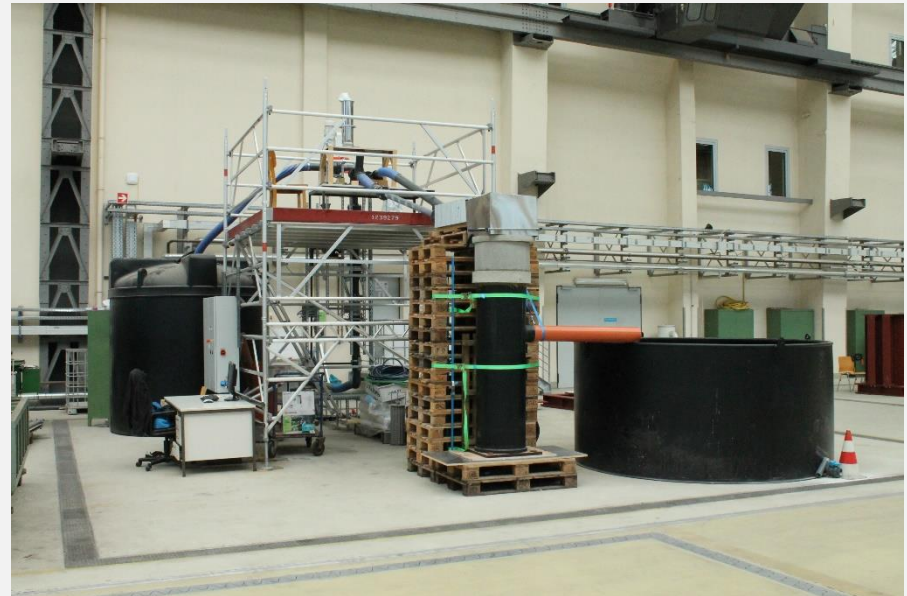


Funke Kunststoffe GmbH



Test facility

- Technical data:
 - Defined volume flow 0,1 l/s-16 l/s (up to 3.600 l in 15 min)
 - testing of different filtersystems
- Testing: addition of define amounts of pure substances
- Optimization decentralized filter systems
- Transportations of particles on the street surface



Test substances

› Minimum of two repetitions of test series

› PS

- › \varnothing 69 μm , \varnothing 250 μm
- › $\rho = 1,05 \text{ g/cm}^3$

› PE

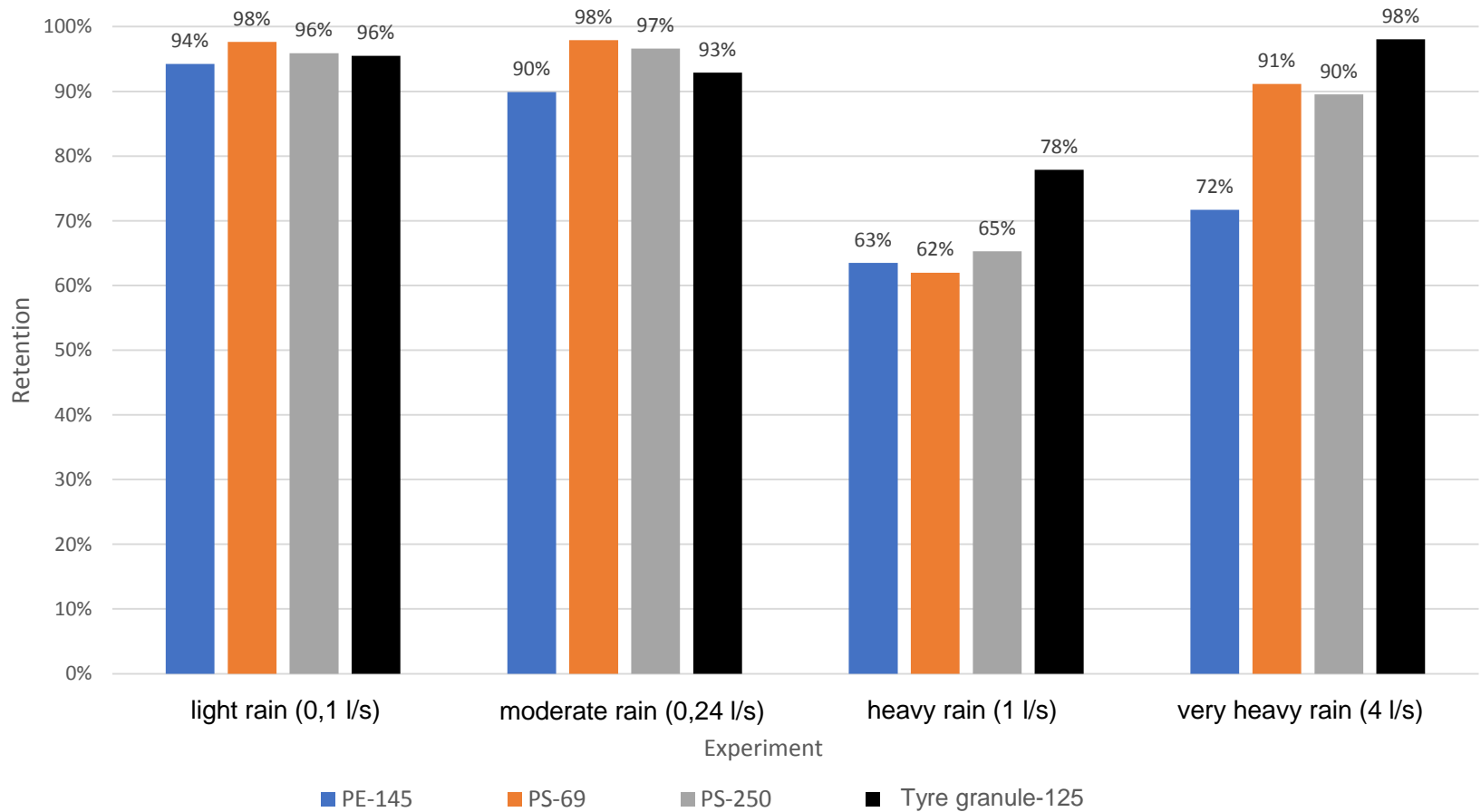
- › \varnothing 145 μm ;
- › $\rho = 0,95 \text{ g/cm}^3$

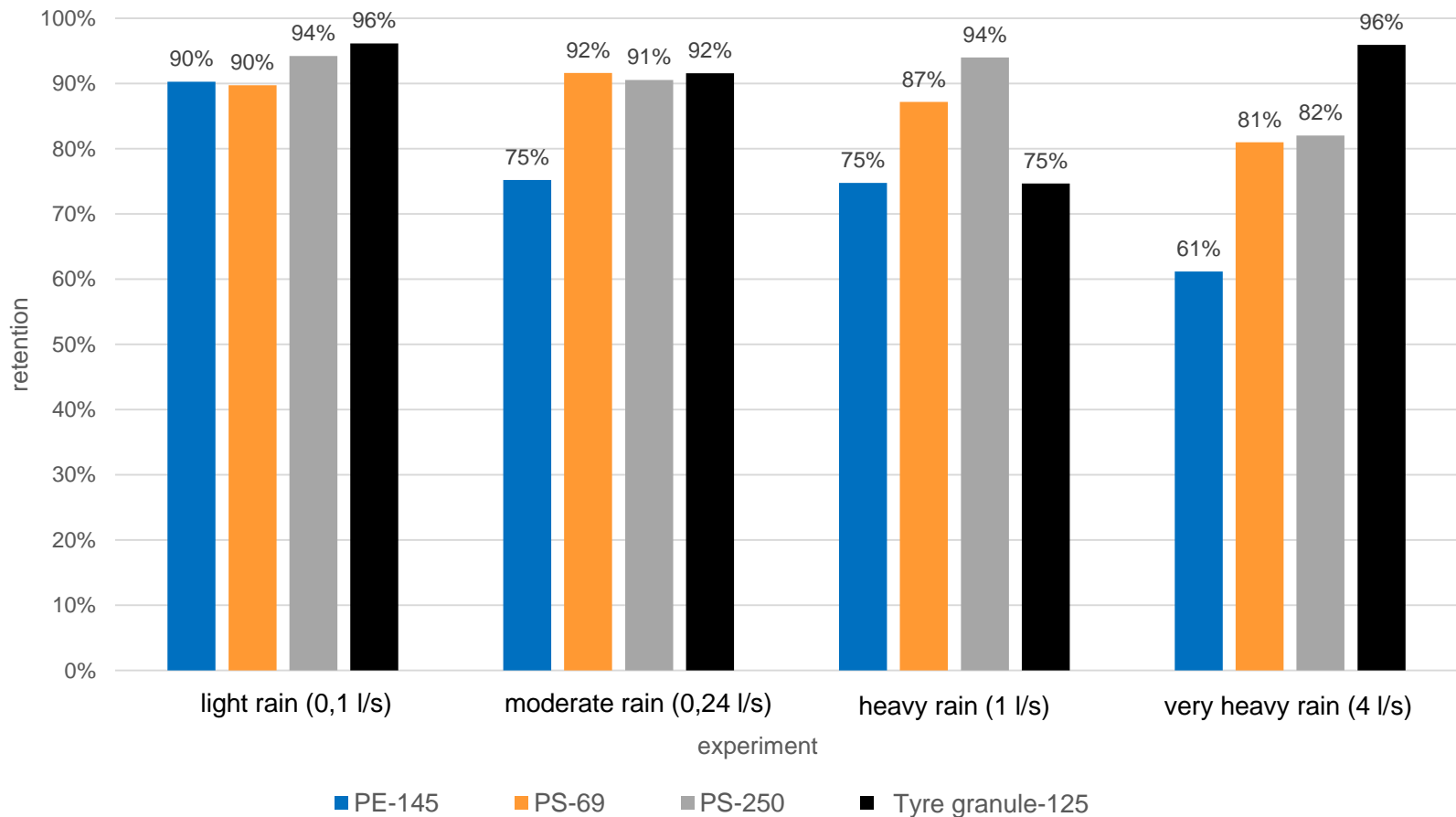
› Tyre granule

- › \varnothing 125 μm
- › $\rho = 1,17 \text{ g/cm}^3$

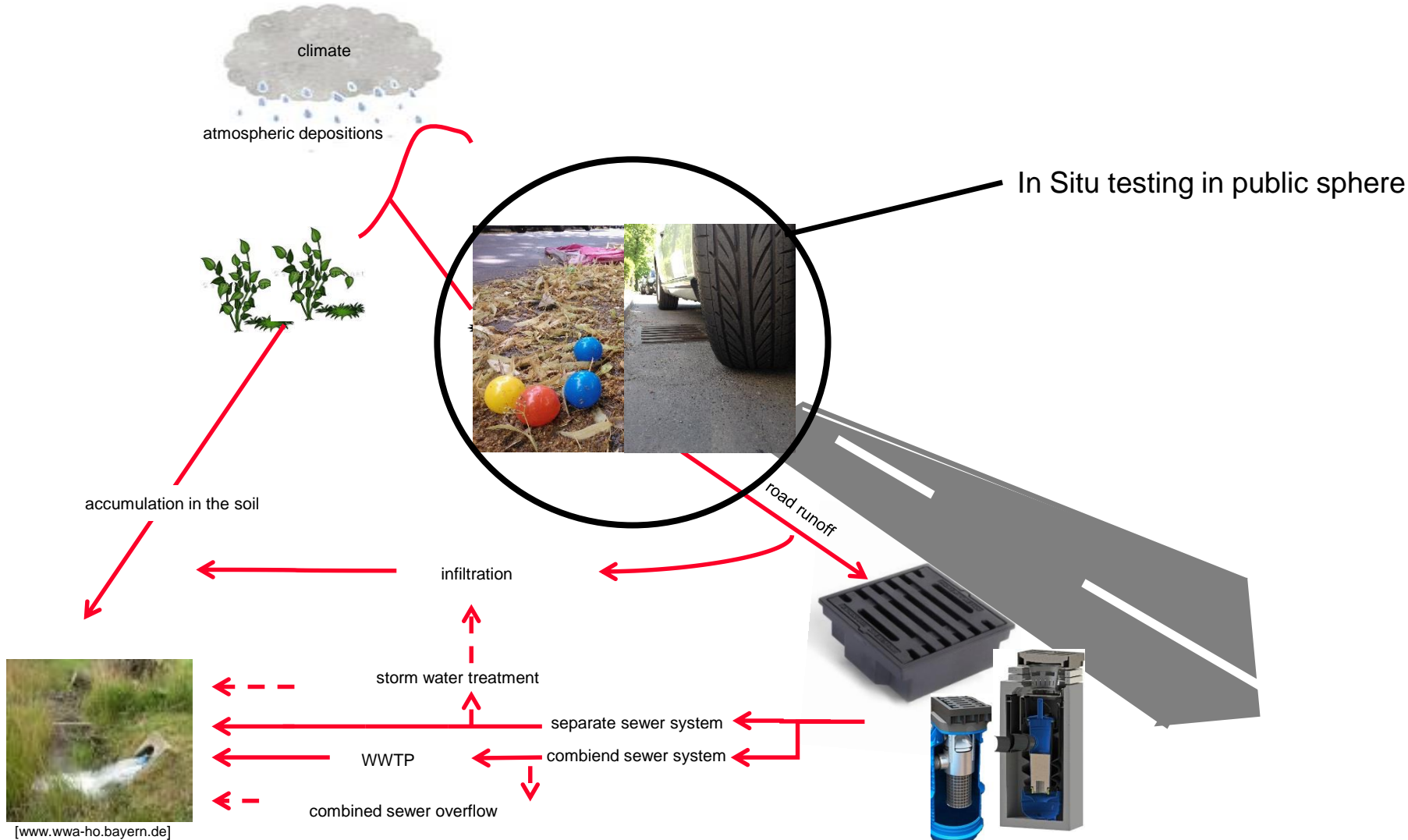
› 115,2 g of each substance in 4 experiments







In-Situ Testing



In-Situ Testing

In-situ-measurement

- Real water samples
- Experience in operation and maintenance
- Investigation of the street sweepings

Survey areal with 6 road gullies, which lead the street runoff in sample chambers

- Reference gully
- INNOLET®-G, Funke Kunststoffe GmbH
- BUDAVICI Typ-N, MeierGuss Sales & Logistics GmbH & Co. KG



Sampling

- › Difficulties
 - › Quality of the sample (representative status)
 - › High variations in chemical composition
 - › Detecting the storm event at an early stage
 - › High sample volume



Probenehmer Basic Ex 1 mobil

Sampling

- Event-driven, automatic sampling, managed by a conductivity sensor
 - Bluetooth signal as start impulse
 - Notification by sms
- Optimization of the suction unit
- Minimum flow (for starting the sample) reduce from 0,3 l/s to 0,035 l/s

Optimized suction unit



Optimized sampler



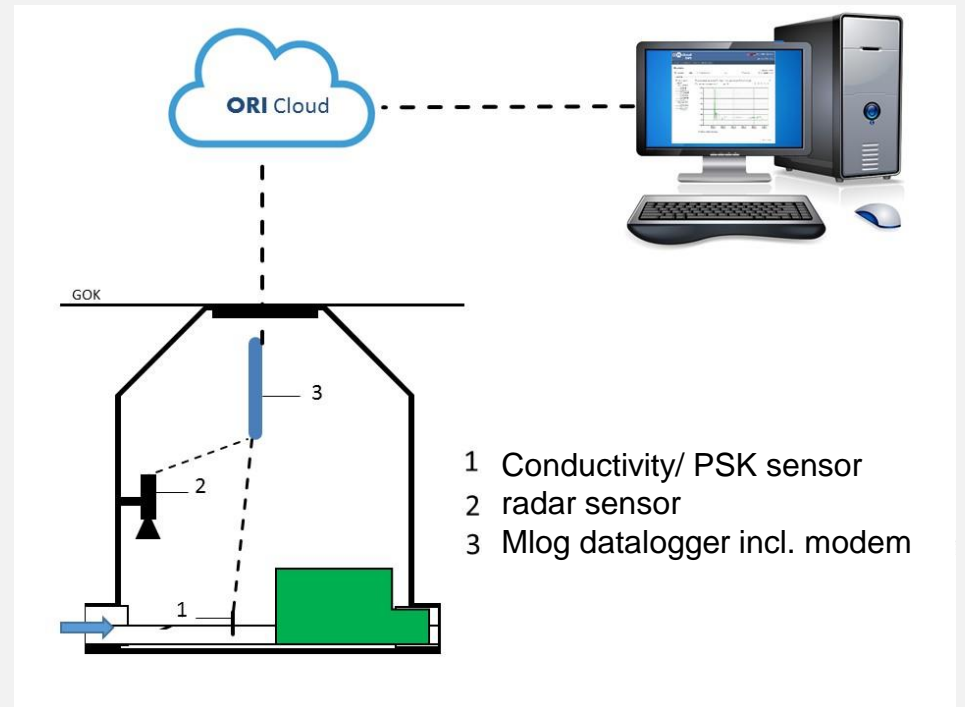
Sample chamber facility

- › Conductivity sensor InPro 7100i is connected with Mlog- Multitool Logger
- › Sensor is fixed in the open sewer at a height of 2 cm
- › Bluetooth-signal for starting the sampling



Datacollection and datapresentation

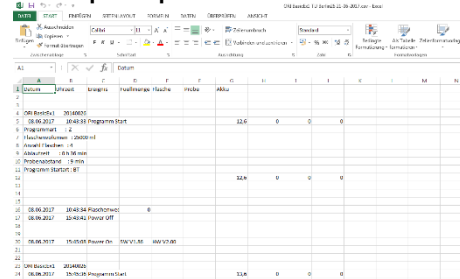
- › Continuous data collection
- › Optimization of the operation



Datacollection and datapresentation

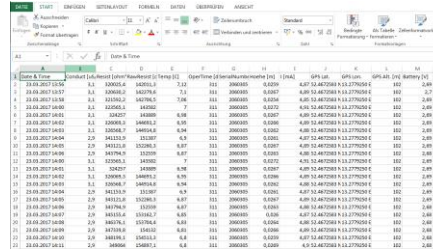
- Automatic compilation of all data
- Identification of Correlations

Sampler protocol

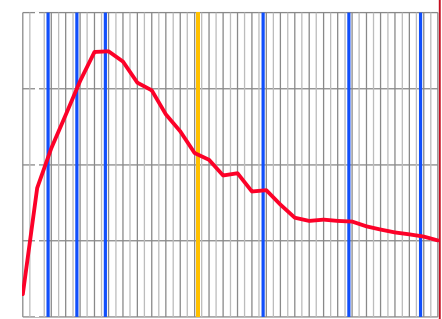


Datum	Anzahl	Temperatur	Druck	...
28.06.2017	10	12.0	0	0
28.06.2017	20	12.6	0	0

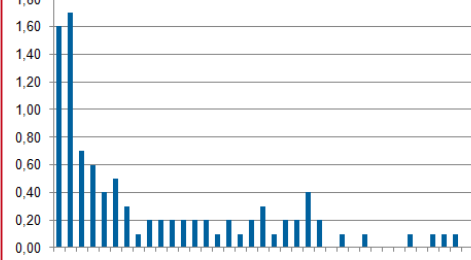
Flow measurement



Datum & Uhrzeit	Ordnungszahl	Leitungsdruck	Leitungsdruck (Pa)	Leitungsdruck (mbar)	Leitungsdruck (mmHg)	Leitungsdruck (inHg)	Leitungsdruck (psi)	Leitungsdruck (kPa)	Leitungsdruck (MPa)	Leitungsdruck (bar)	Leitungsdruck (atm)
28.06.2017 08:00	1	10000	10000	100	750	10.13	147	10.0	0.10	1.0	1.01

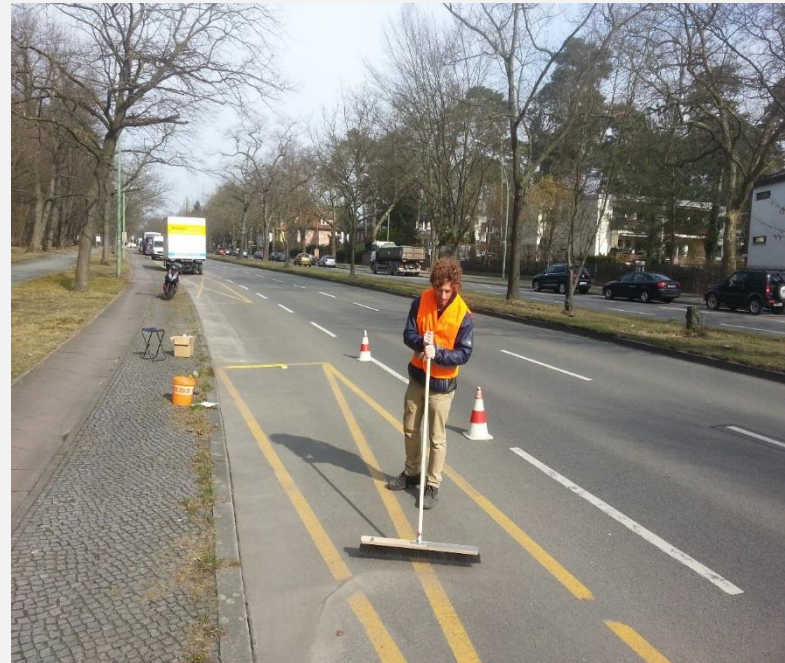


Precipitation data



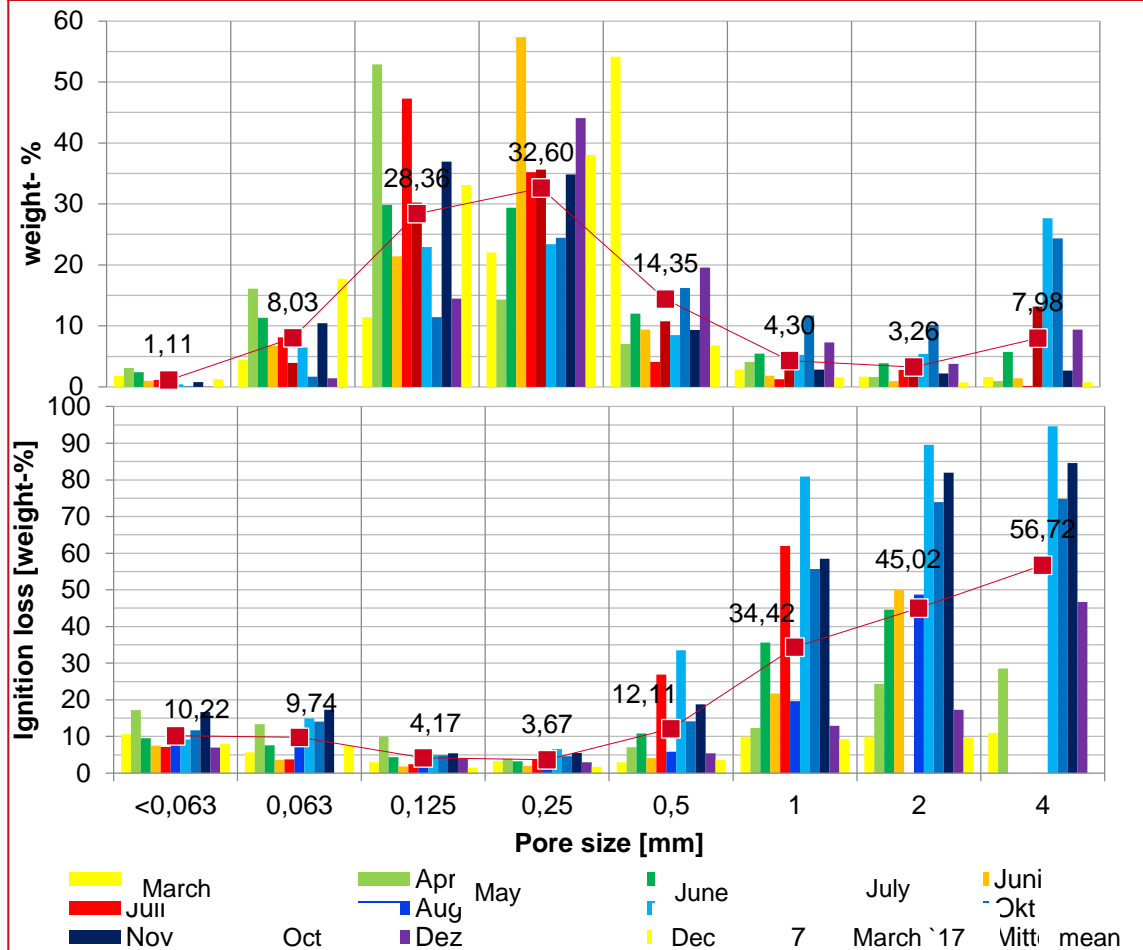
In-Situ Testing

- Sweeping from an defined street section of 40 m²
- Samples every month over 1 year
- Subsequent analysis:
 - Particle size distribution
 - 4.000 μm
 - 2.000 μm
 - 1.000 μm
 - 500 μm
 - 250 μm
 - 125 μm
 - 63 μm
 - determination of the loss on ignition



Investigation of street sweeping

- > Largest mass fraction of solids in the range of 125 μm – 500 μm
- > Organic matter increases with particles smaller 125 μm and bigger 250 μm



Outlook

- › Ongoing investigations of street sweeping
- › Optimization in operation and maintenance of the road cleaning and drainage
- › Analysis and detection of microplastic in each fraction
 - › We detect PE, PS, PP in road runoff

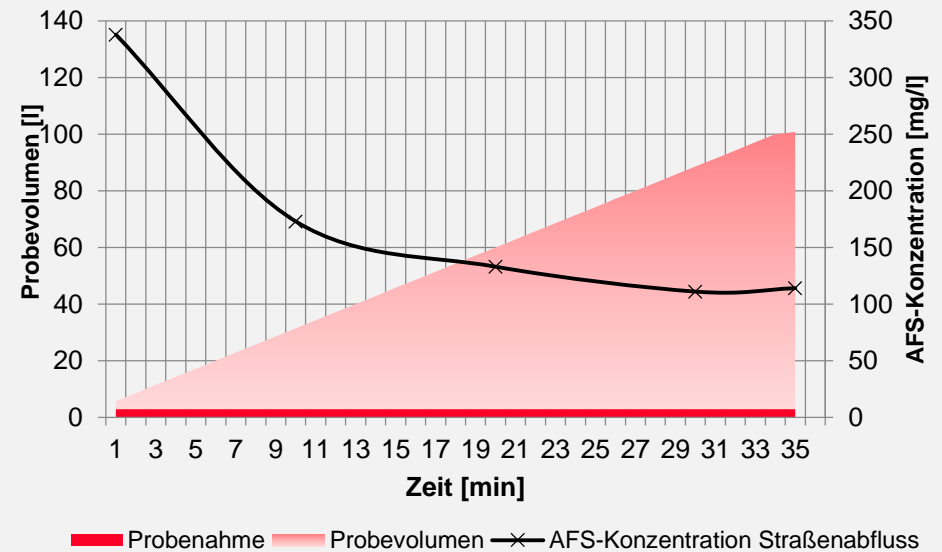




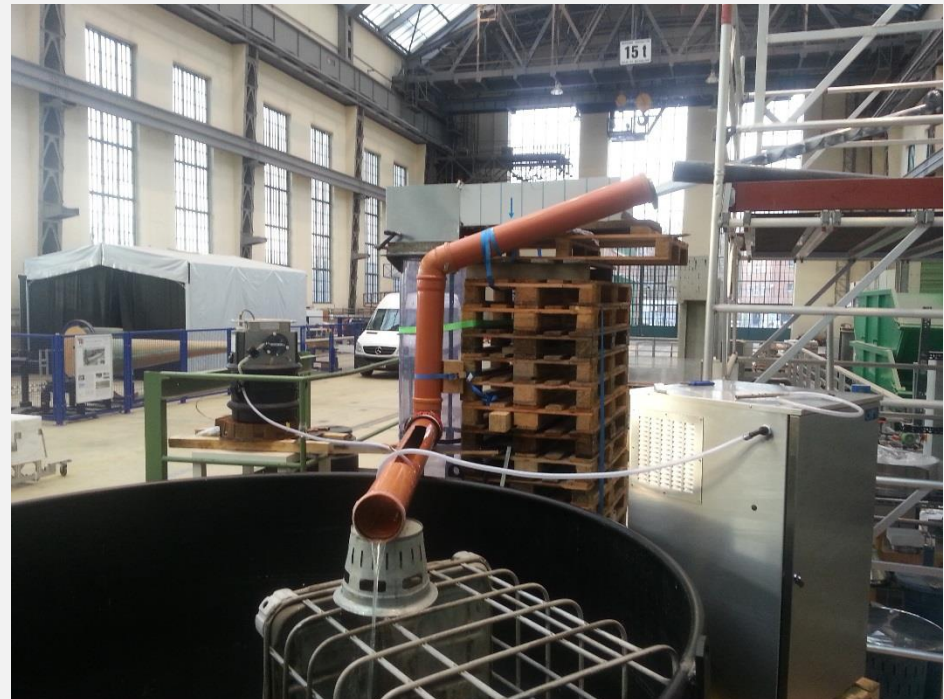
Thanks for your attention!

In-Situ sampling

- Time continuous, event controlled, automatic sampling in explosive area



- Testing the performance of the automatic sampler
 - By recovery experiments with various substances and flow rates
 - Investigation of further influential factors



Rain intensity

Experiment	Rain intensity [l · (s · ha) ⁻¹]	Rain intensity* [l · min ⁻¹]	Duration [min]	Total [l]
1	2,5	6	240	1440
2	6	14,4	100	1440
3	25	60	48	2880
4	100	240	15	3600

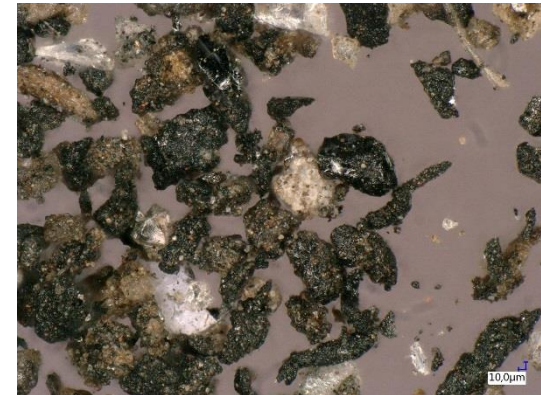
* Referred to a supplied area of 400 m²

Annual plan

2016														2016								2017						
	Januar	NN [mm]	Februar	NN [mm]	März	NN [mm]	April	NN [mm]	Mai	NN [mm]	Juni	NN [mm]	Juli	NN [mm]	August	NN [mm]	September	NN [mm]	Oktober	NN [mm]	November	NN [mm]	Dezember	NN [mm]	März	NN [mm]		
1.					x								10,9	x (RS)						7		2		1,2	1.		1,6	
2.			x				x						2,7		2,4	x	3,2				4,3	x x (RS)	1,4	x		2.		3,6
3.									437 g						1,1										3.			
4.							x						x (RS)	297 g		13,3		4,7	x						4.			
5.			WD			2,3	562 g						2,9	x	1,5		x				4,2		7,2		5.			
6.						5,1		1,3	x						1,7						2,3		2,1		6.		14,4	
7.					x																1,5			x	7.			
8.			x		1905 g						x		x (RS)	8,1		466 g					1,3	x			8.		4,5	
9.			5504 g	2,8											x	251 g					593 g				8,6	10.		
10.	WD	2,8		1,9																	2,8				13	11.		
11.	WD	4,6		1,4					x												2,5					12.		
12.	WD	4,4								4,1			1,2													13.	2058 g	
13.	WD	2,5								4,5			1,6		18,4				x							14.		
14.	WD									3,1		x	6,3	1,5	x									x		15.		
15.	WD				x		x			16,1		2,6	9,2	x							3,4		x	1,7	949 g	16.		
16.	WD	2								2			6,8			x						x	1,7			17.	4	
17.	WD												13,6	1,6	x						1,4		6,7	1,1	18.			
18.	WD												4,8			3,8			x		4,3		3,3	x	19.			
19.	WD		x						x							19,7	x			470g						20.		
20.	WD			6,5			x					876 g		x												21.		
21.	WD			10,9	x		1,6																			22.		
22.	WD			7,9			2,4																			23.		
23.		2,6	x																							24.		
24.		3			x (RS)																					25.		
25.				2			4	x																		26.		
26.																										27.		
27.																										28.		
28.							2,3	x																		29.		
29.							4,9																			30.		
30.		5,1			x																					31.		
31.					x (RS)				x																			

Tag der Probenahme	Niederschlagsmenge
x Straßenreinigung	x(RS) Handreinigung Rinnstein
WD Winterdienst	

Microscopic examination



Representative status of sample taking

Particle size [mm]	Test substances [g]	Retrieved test substances [g]	Representative status [%]
5- 4	41,64	42,48	102
4- 2	413,24	414,26	100
2- 1	403,62	404,35	100
1- 0,5	365,53	366,56	100
0,5- 0,25	437,06	438,66	100
0,25- 0,125	173,26	163,12	94
0,125- 0,100	125,54	112,42	90
< 0,100	31,48	21,65	69



heavy metal analysis (Zn & Cu)

