

Measures to reduce the input of tyre material into the environment

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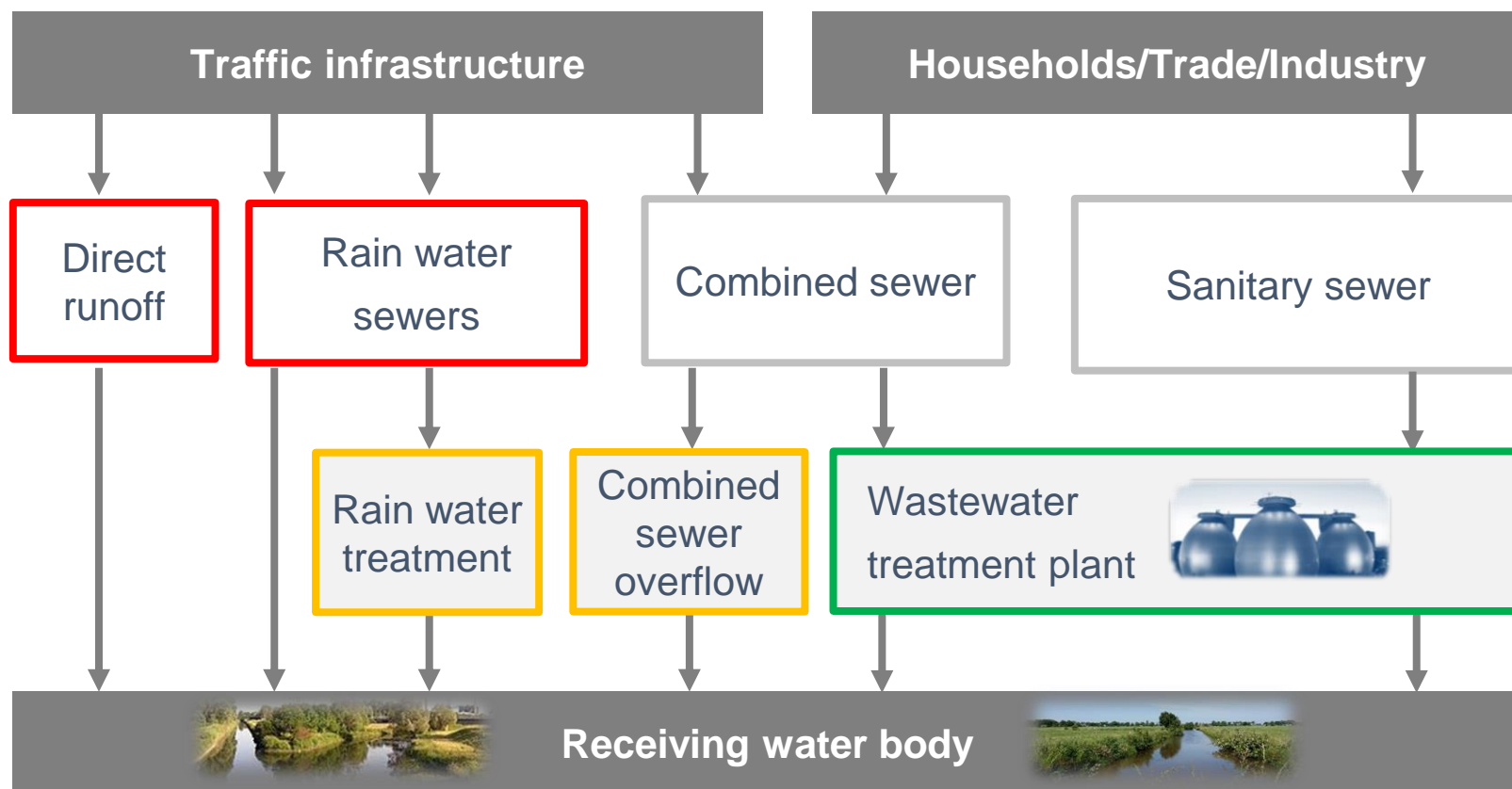
Top-Ten of microplastic emissions, Germany

Total: 330.000 t/a; 4.000 g / (c□a)

	Source	„Umsicht“- Report	Min.	max	Urban Water Management
1	Tyre wear	1,228.5	49.6	1,357	++
2	Release from waste disposal	302.8	-	-	++
3	Abrasion bitumen in asphaltos	228			
4	Pellet losses	182	0,5	2,567.2	++
5	Drifts from plastic sports fields	131.8	-	-	+-
6	Release from construction sites	117.1			+-
7	Abrasion from shoe soles	109	17.5	175.4	
8	Abrasion from plastic packaging	99.1	-	-	
9	Abrasion from road markings	91	19.3	121.1	
10	Abrasion from textiles during laundry	76.8	-	-	++
13	Flocculants in urban water management	42.5	-	-	++
17	Microplastics from cosmetics	19.0	1.6	11.0	

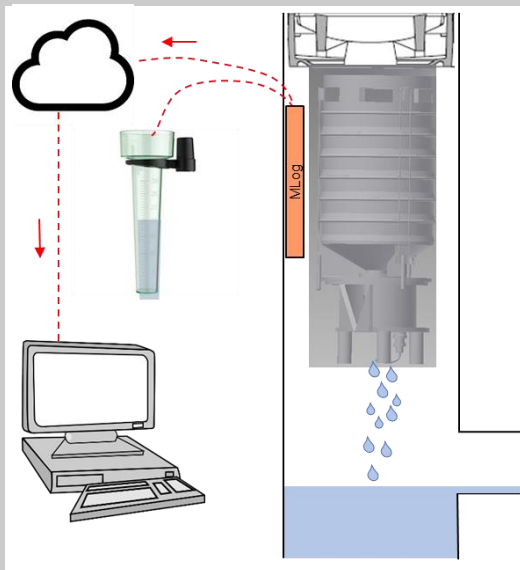
Bertling et al. 2018

Pathways of microplastic into the aquatic environment



Sample taking and analytics

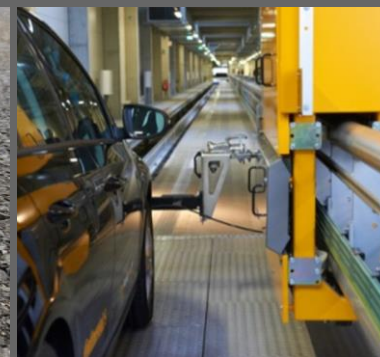
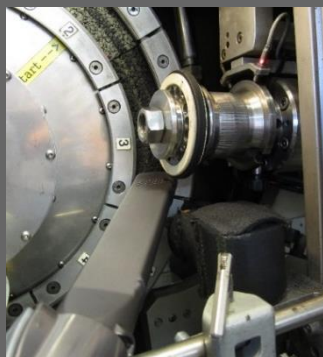
road runoff



road sweepings

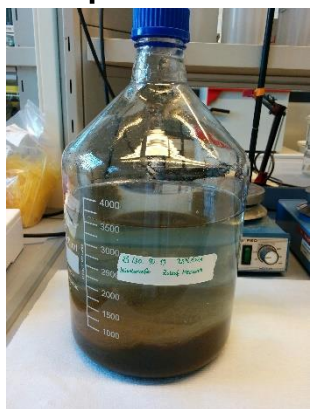


Contidrom



Pre-treatment of sample

Sample Arrival



Freezing



Freeze drier



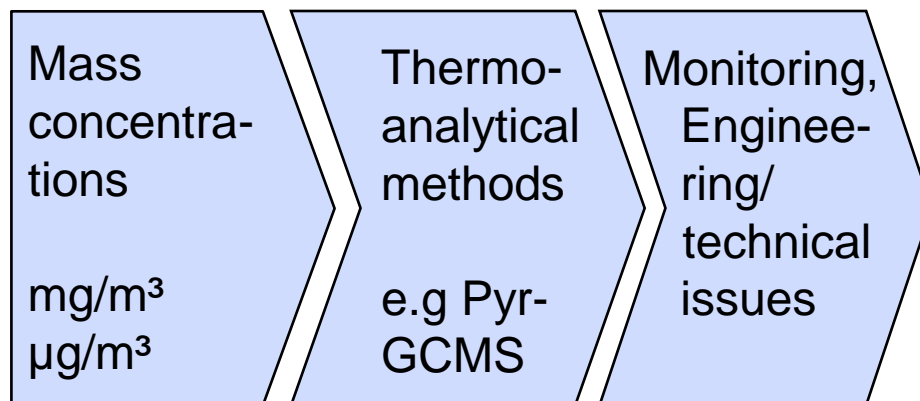
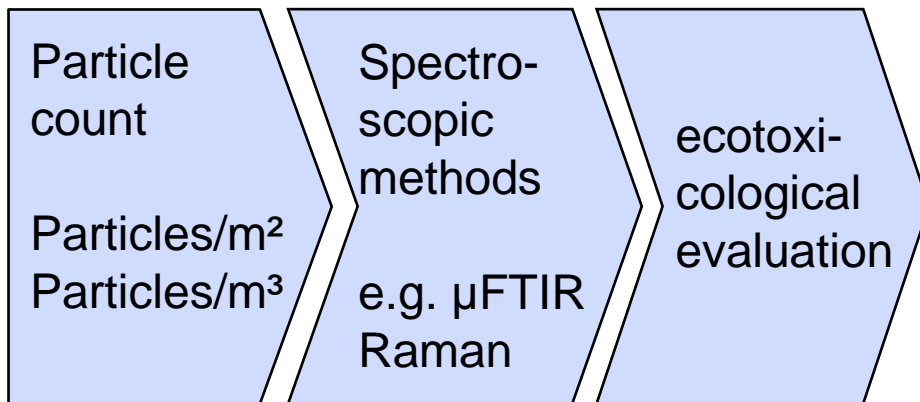
Weighing



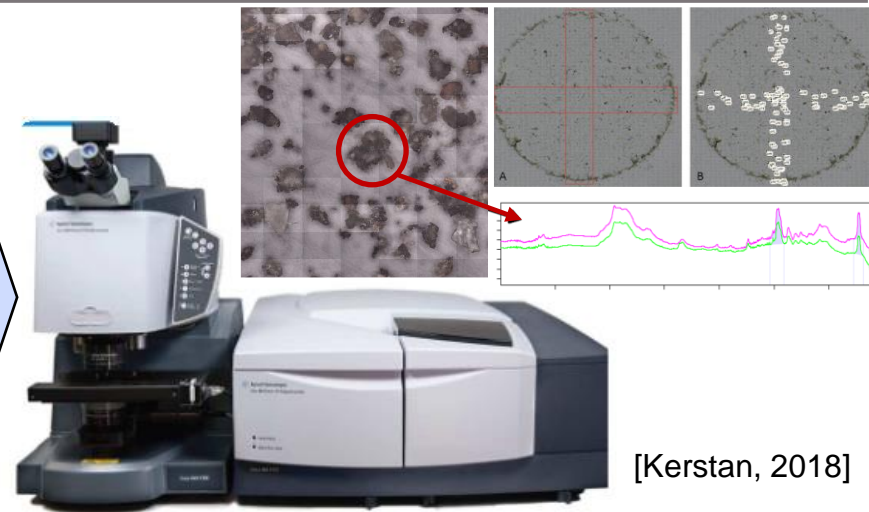
Milling



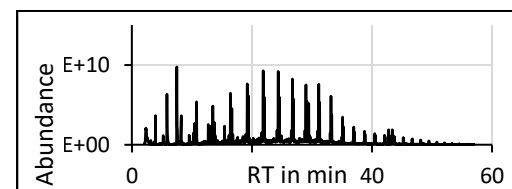
Microplastic determination particle number or mass?



TED-GC/MS: Thermo Extraction Desorption
– Gas Chromatographie/ Mass spectrometry



[Kerstan, 2018]



[www.gerstel.com/en/TED-GCMS.htm]

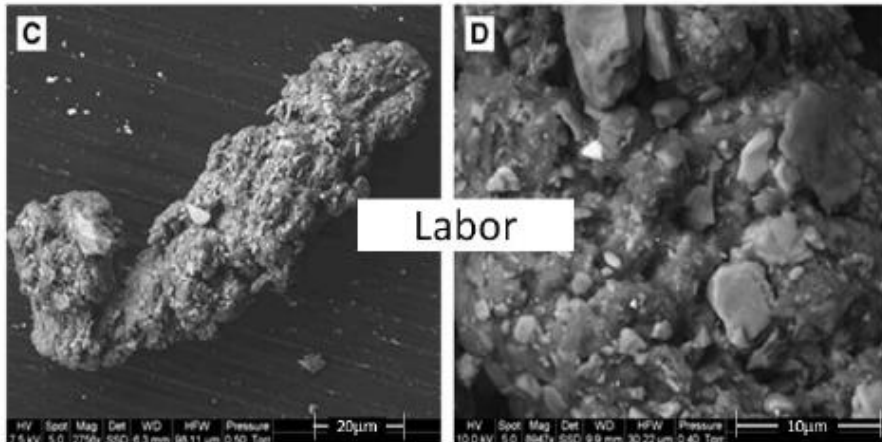
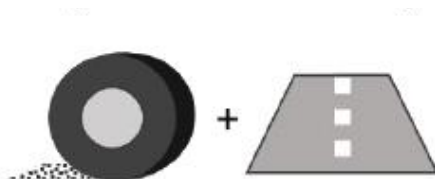
Emissions by Stormwater - Tyre Wear -

Tire wear

scanning electron micrographic picture

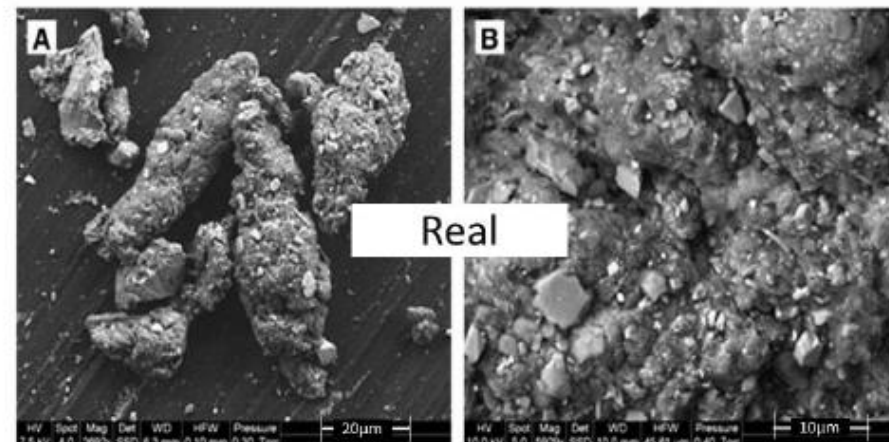
TWP

Tire wear particle



TRWP

Tire and road wear particle

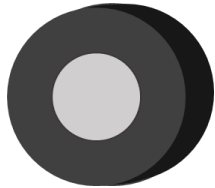


Size: 5 – 350 µm (average 100 µm)

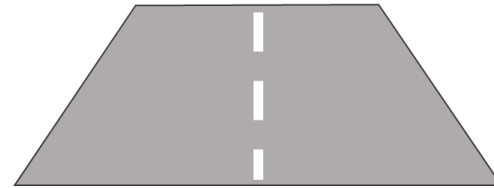
Kreider et al. 2009

Influencing factors

Tyre characteristics



Road surface characteristics



Vehicle characteristics



Vehicle and driver operation



Emission factors – Engine power

Gebbe et al. 1997

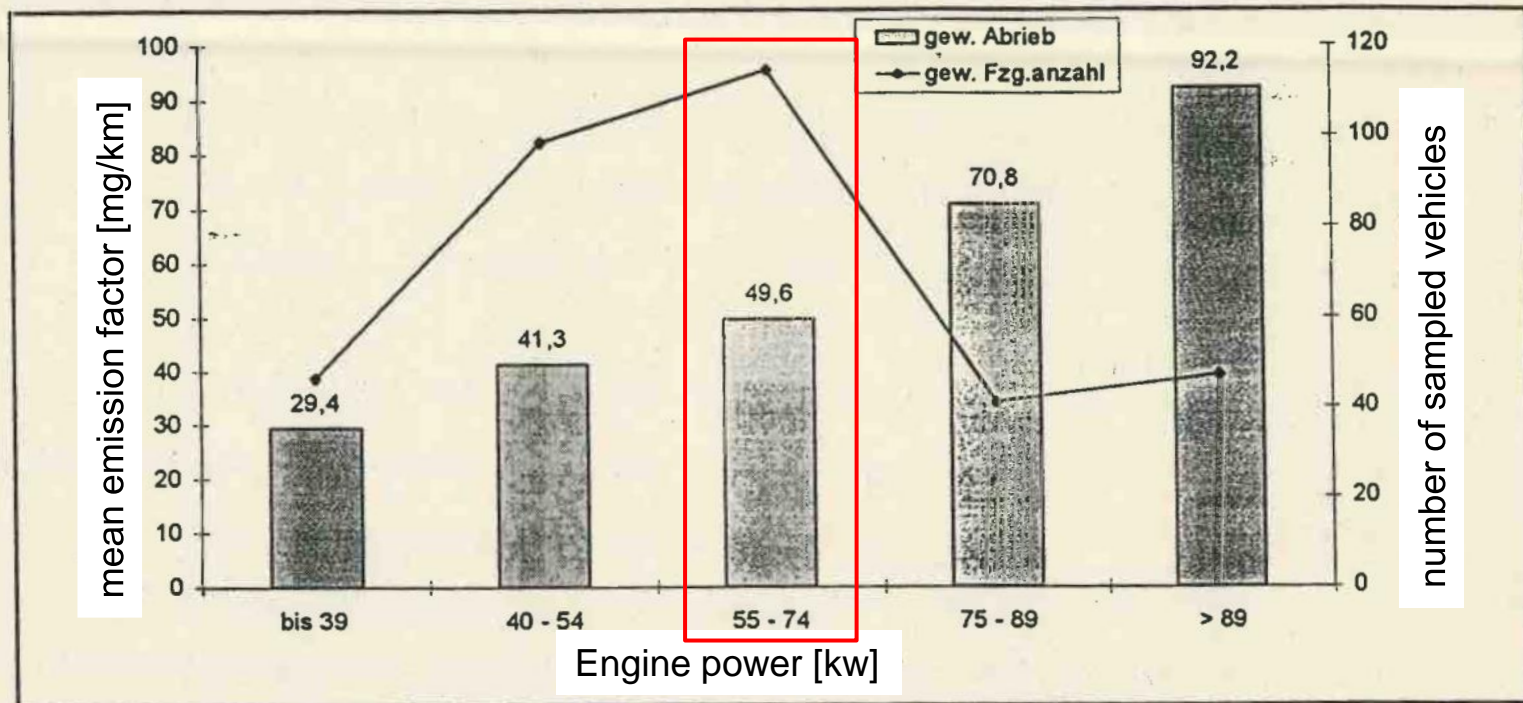


Abb. 6.14 Mittlere Abriebsraten der gewichteten Pkw-Stichprobe, geordnet nach der Motorleistung

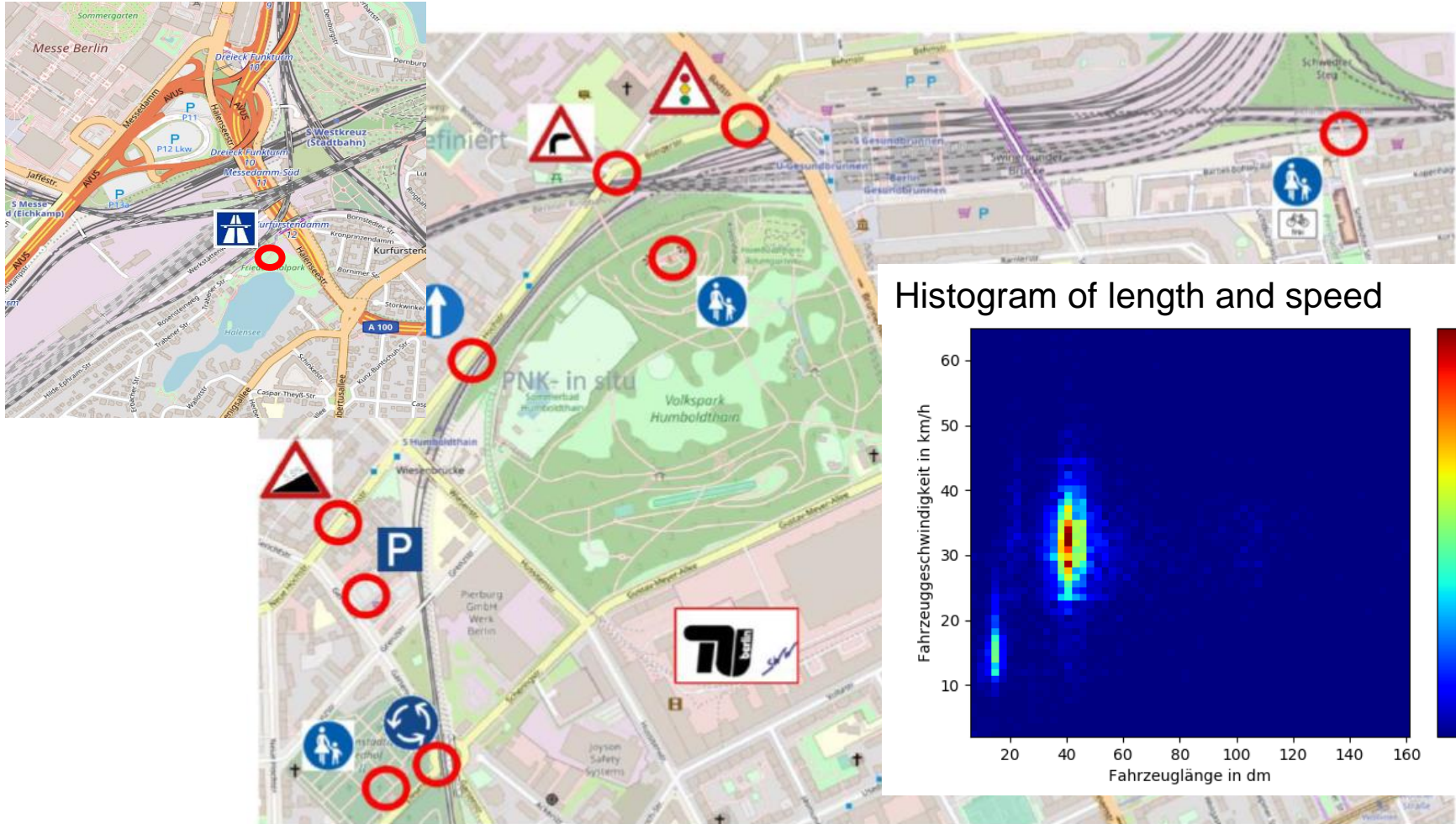
[Gebbe et al. 1997]

Average engine power of
new registrated **passenger cars: >90 kw**

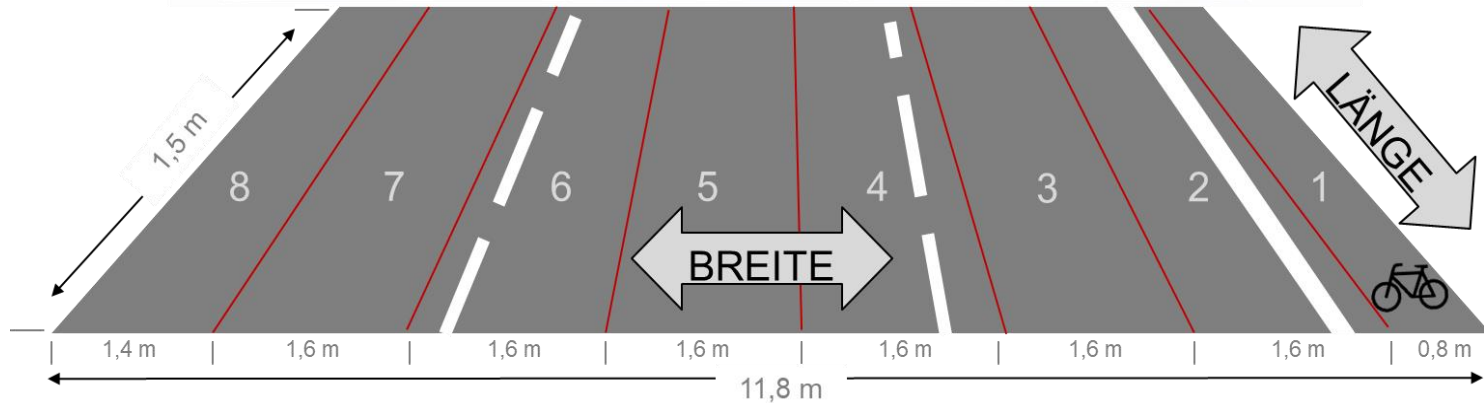
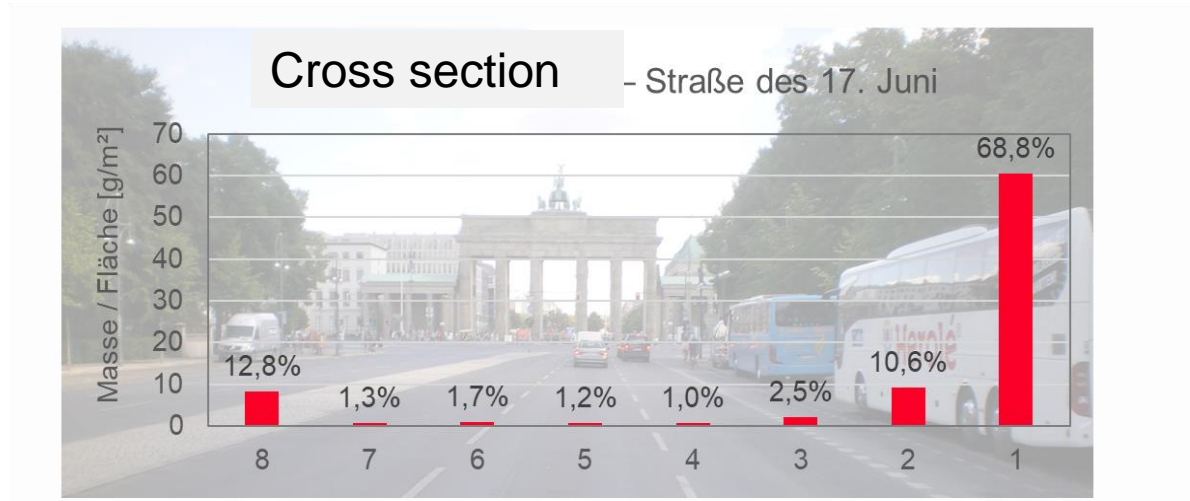
[Statista]

Main measurement points

Daily, Basket for sample taking

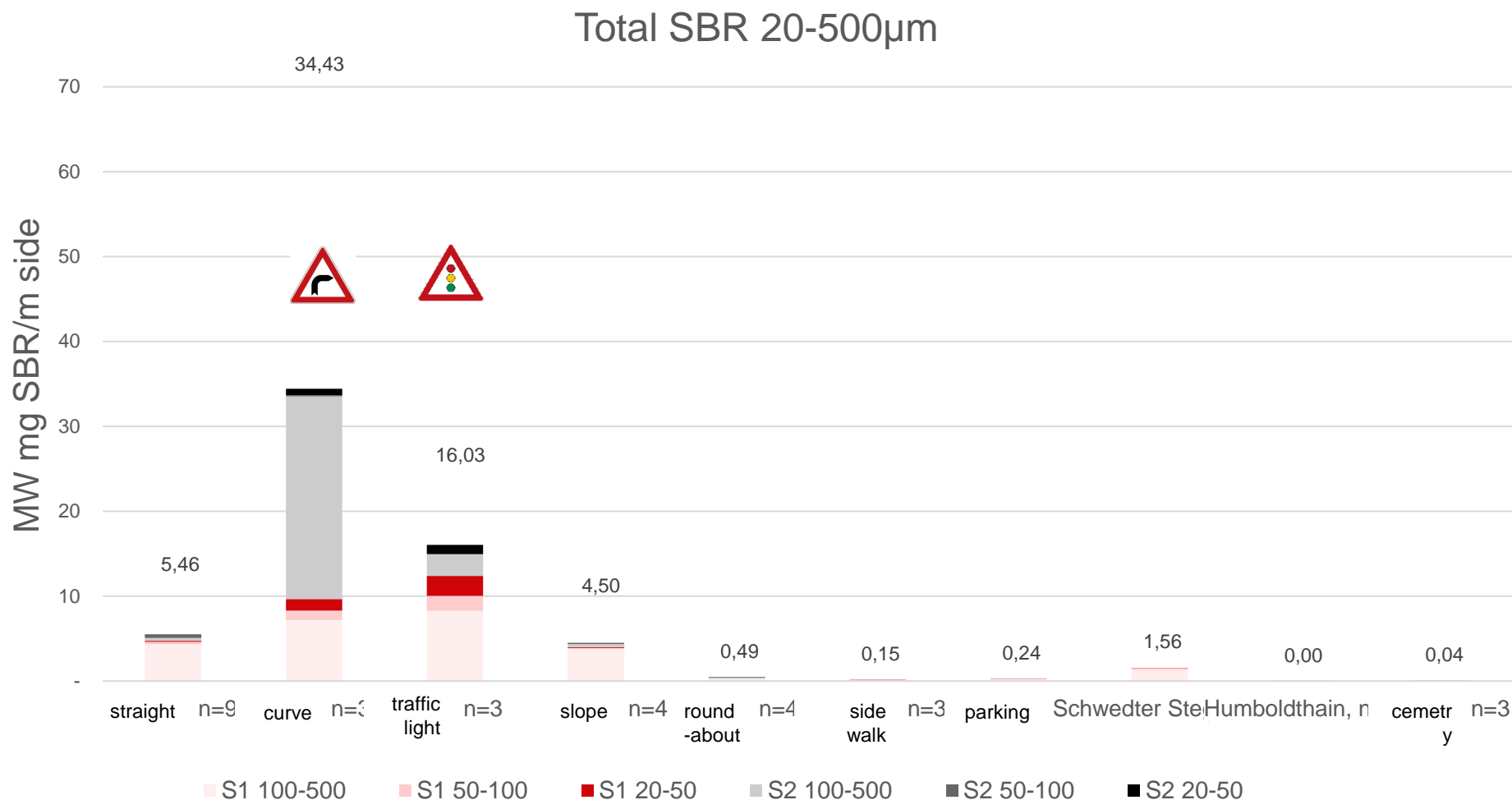


Mass distribution on the road



Urban Hot Spots

Results of hand sweeping



SBR: styrene-butadiene rubber



	Urban	Rural	Motorway
TWP (Germany)	29 %	33 %	38 %
[Baensch-Baltruschat et al. 2020]			

	Urban	Rural	Motorway
TWP (EU)	40 %	40 %	20 %
[Eunomia et al. 2018]			

	Urban	Rural	Motorway
Surface Water	17,1 %	~ 0 %	3,0 %
Soil	2,8 %	32,5 %	34,0 %
Air	5%	5 %	5 %

[Baensch-Baltruschat et al. 2020]

Tyre wear emission

Germany	111 420 t/a	1.4 kg/(Ca·a)
EU	450 000 t/a	1.0 kg / (Ca·a)

What are measures to reduce the impact of tire wear

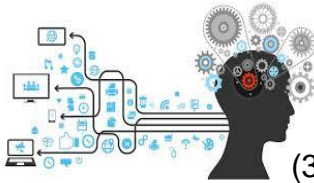
Material innovation



(1)

Intelligent Network

AI

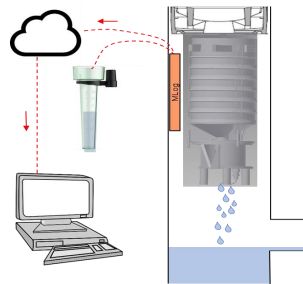


(3)



(4)

Optimised street cleaning



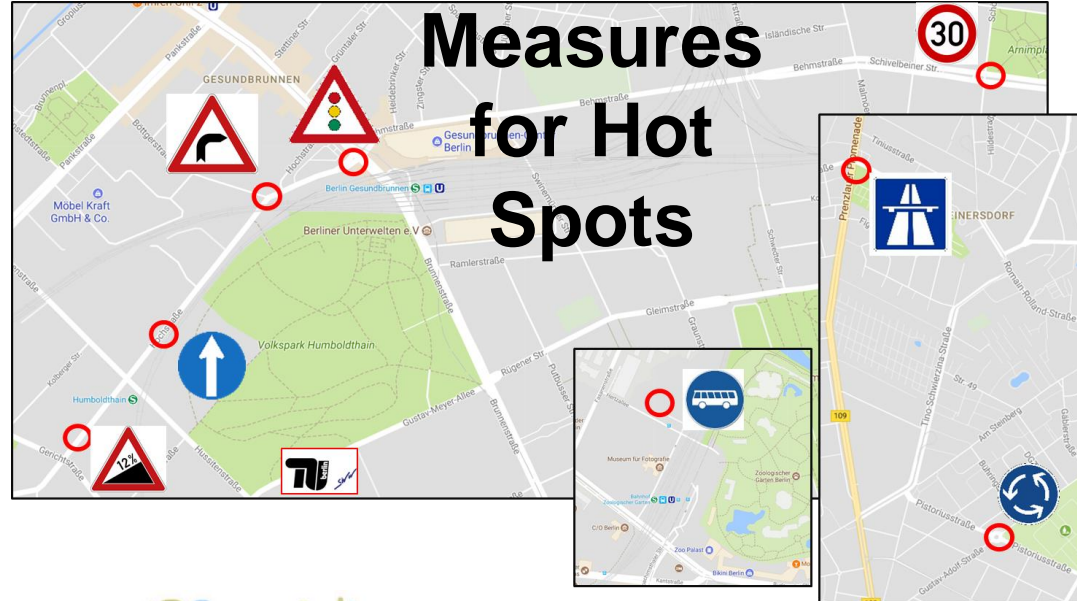
In situ sample taking



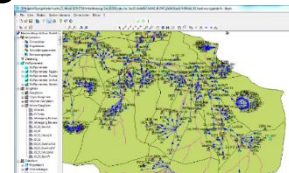
(5)

Appreciation for the material plastic

Measures for Hot Spots



Modelling of measures



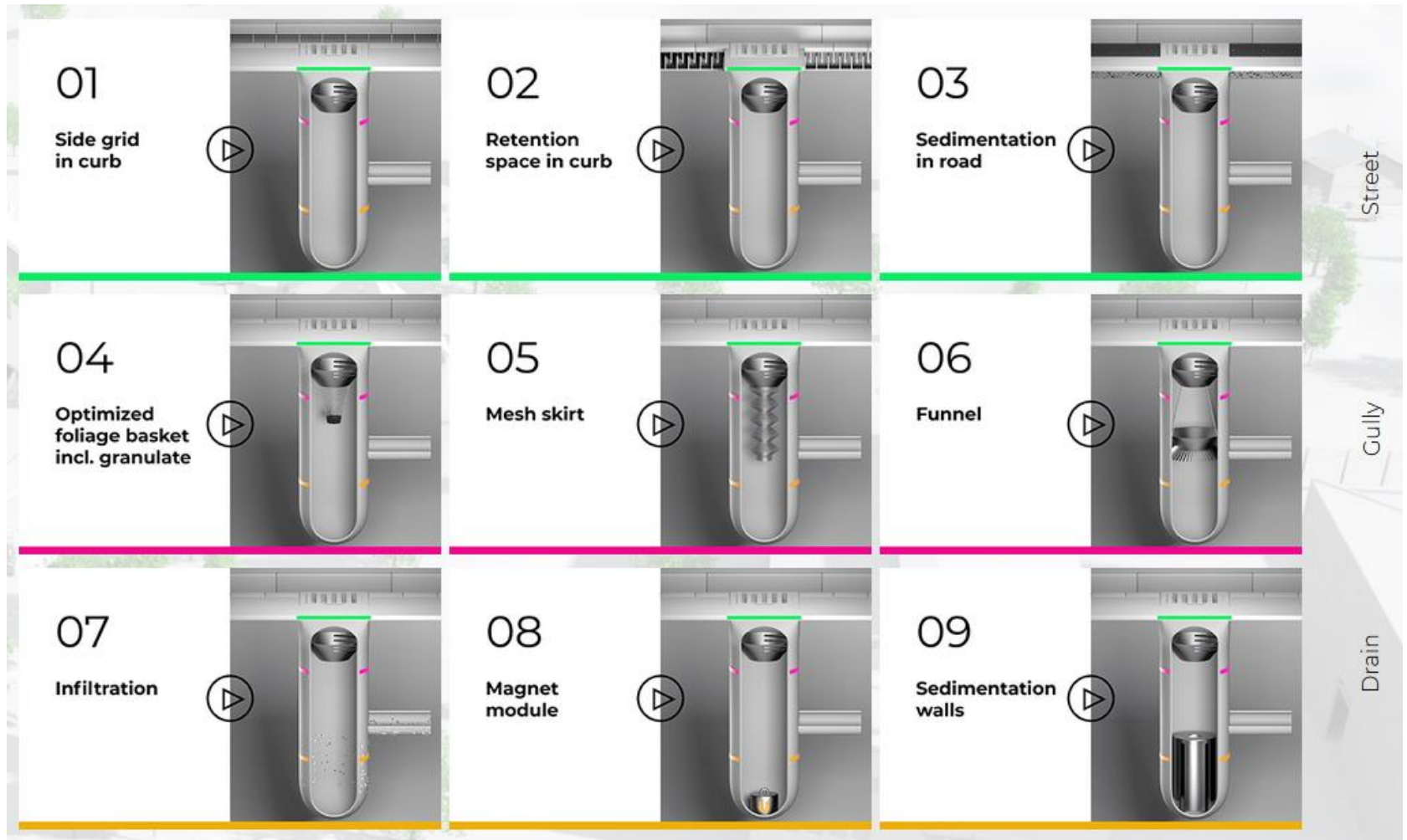
(2)

Advanced wastewater treatment

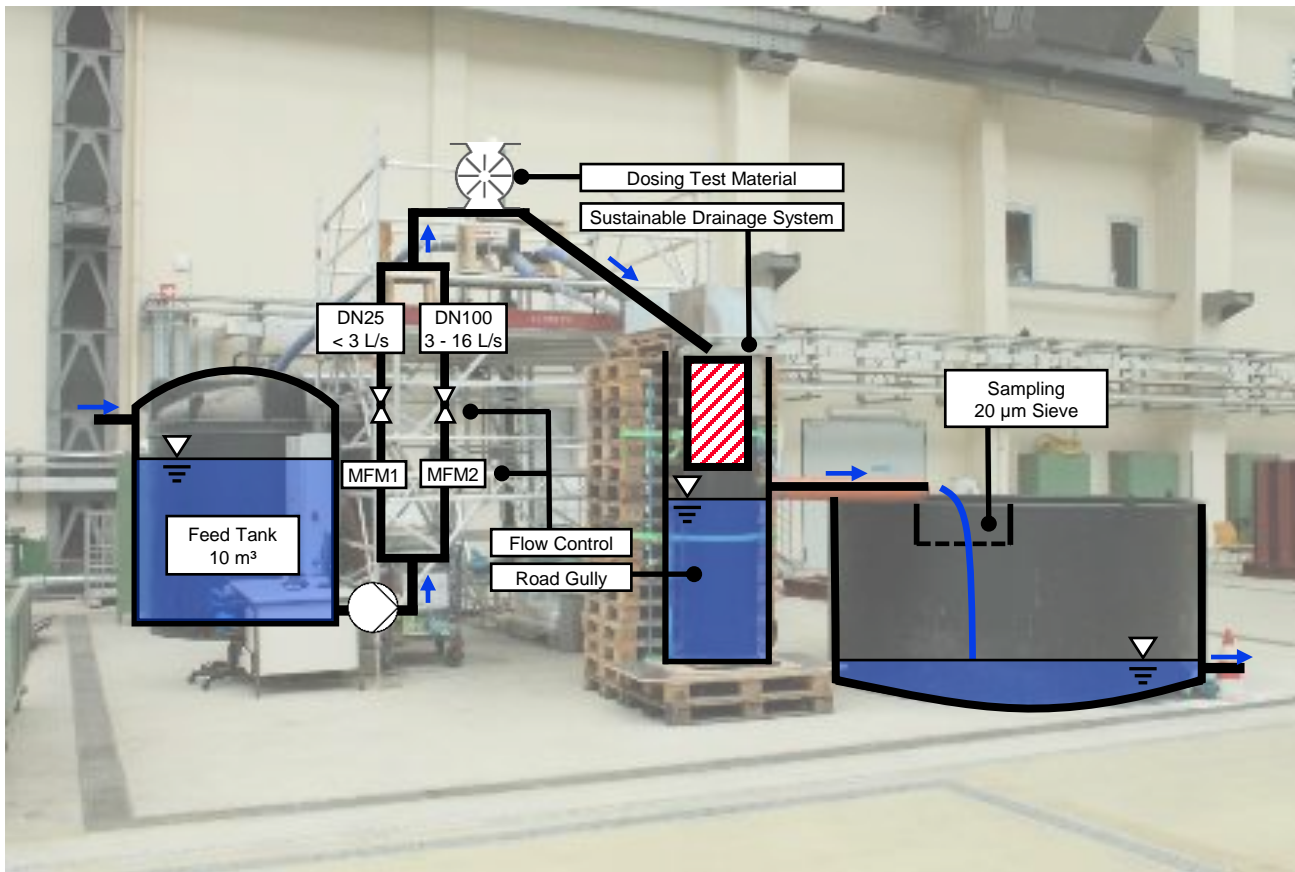
...?!

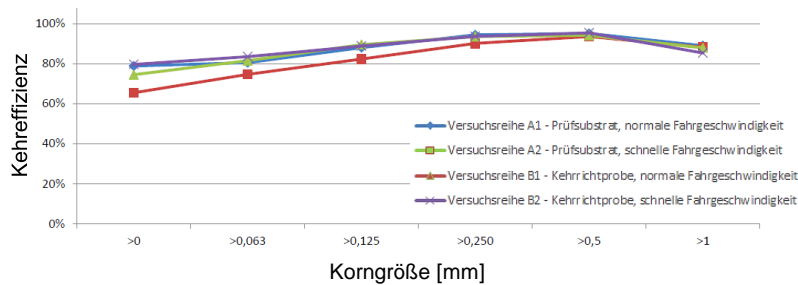
UrbanFilter - 9 moduls for 3 levels

Decentral treatment



Test pilot and standardisation

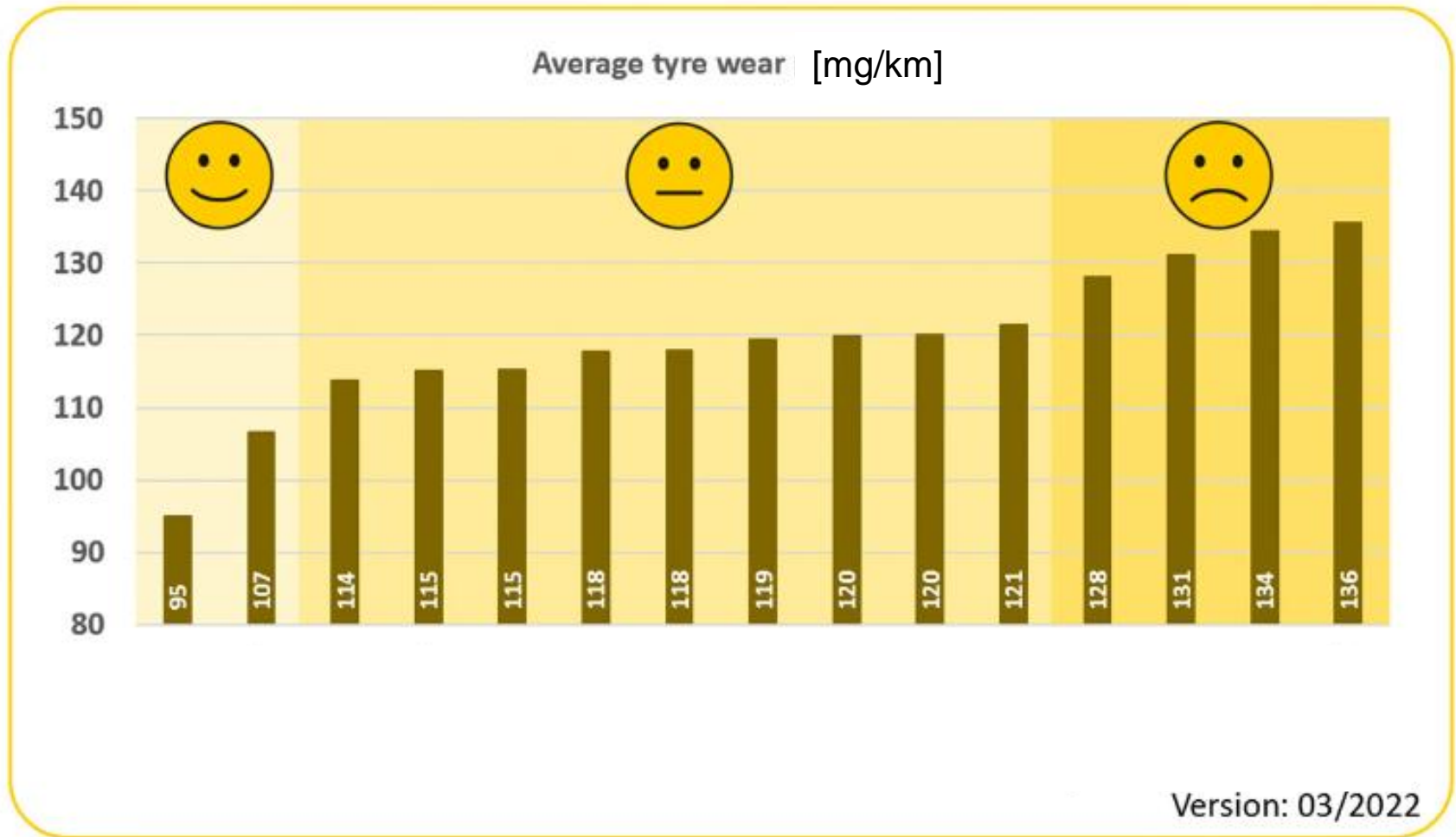




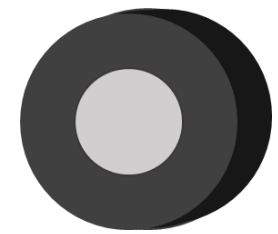
- Measurement of the cleaning efficiency of the street cleaning machine
- Measurement under defined situation in a hall
- Measurement on-Site
- Future idea **intelligent road cleaning** in combination with **rain forecast**

Tyre wear emissions according manufactures

Different tyre composition (ADAC Study)



Quelle: ADAC - 12/2021 / Tyre abrasion: wear and burden on the environment / 31940 RMU



- Eliminating the highest abrasion performing tyres
 - ➔ test method + emission limiting value
- Labelling TWP emission according to the energy label
- Disclose tyre composition
- Extended Producer Responsibility (EPR) for tyre manufacturers (modulated fees)
- Alternative tyre materials
- Extending tyre lifetime
- Monitoring tyre emissions in the environment by adding a tracing material to the tyres

EU Study: Cost-benefit analysis of policy measures reducing unintentional release of microplastics, 2022



- Artificial intelligence and advanced driver assistance systems in vehicles to reduce abrasion
 - ➔ Promoting autonomous driving
- Acceleration and speed limitation in urban areas
- Enhance the monitoring of tyre pressure to reduce emission (not only focused on driver safety)
- Reducing vehicle weight
- Install capture device to collect tyre particles (Passenger / Trucks)
- Continuous axis alignment in vehicle design and maintenance (Tracking)

EU Study: Cost-benefit analysis of policy measures reducing unintentional release of microplastics, 2022

Further possible measures

● ROAD

- ➔ Abrasion rate criteria to be added to road design requirements (e.g., roundabouts) & road material characteristics (porous asphalt / rubber asphalt)

● SUSTAINABLE MOBILITY

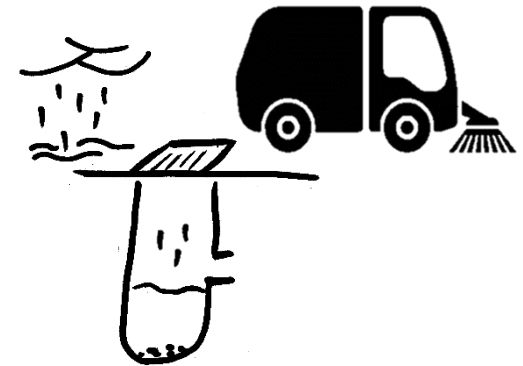
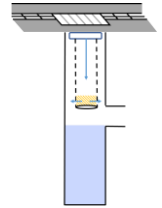
- ➔ Awareness campaigns
- ➔ Speed limits (motorway / urban area)
- ➔ Improve traffic management
- ➔ Reduction automotive individual traffic
- ➔ Mileage / Road transport reduction
- ➔ Promote bicycle traffic



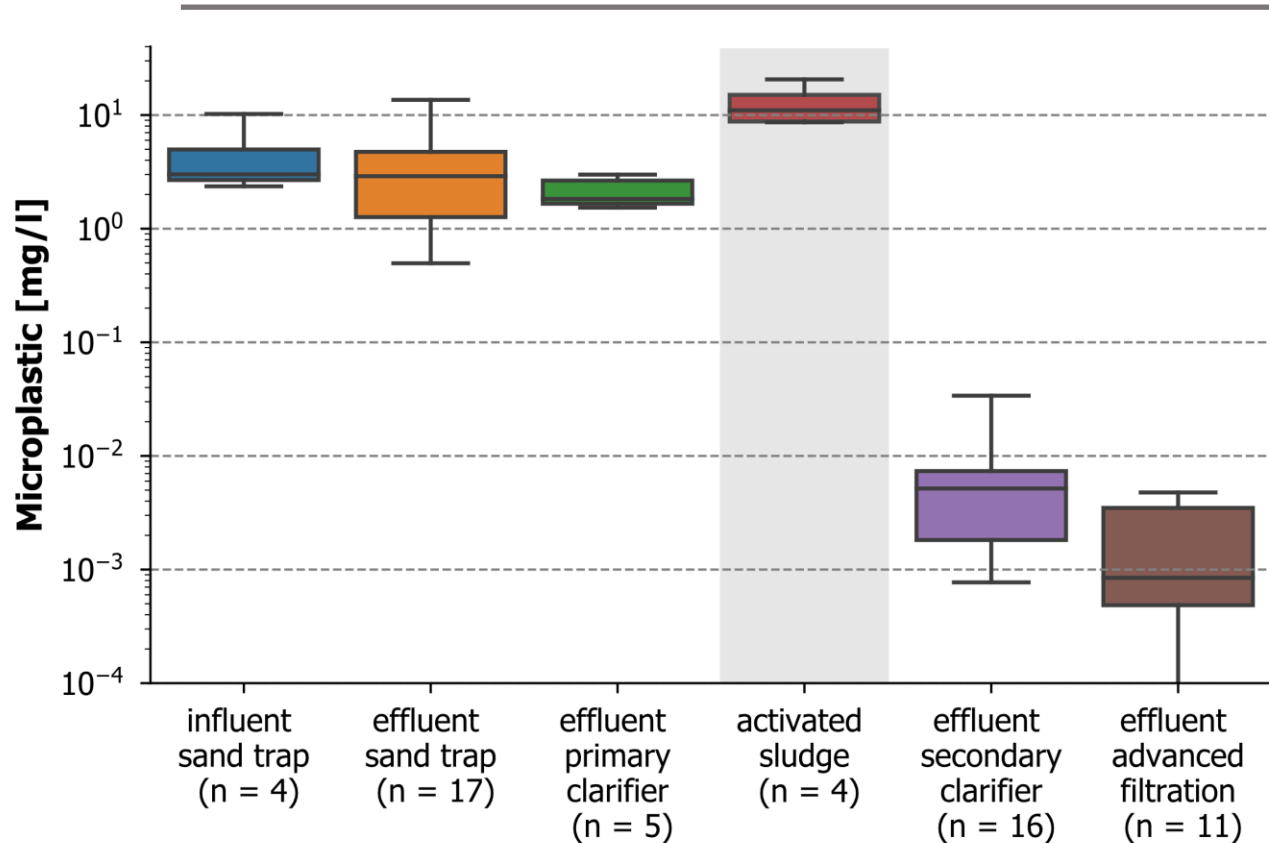
EU Study: Cost-benefit analysis of policy measures reducing unintentional release of microplastics, 2022

Possible measures to treat emissions

- Improve capture and treat road run-off water
 - ➔ (e.g., Filter systems at Hot- Spot for gullies)
- Improve road cleaning in high emission hotspots (Intelligent network)
- Retention soil filters
- Sludge treatment
- Additional field research



Emissions by Wastewater Treatment plant



- High retention of microplastics in conventional treatment plants (> 99 %)
- Further reduction by advanced filtration (> 99,9 %)
- Future focus on combined sewer overflows and road runoff

Summary and Outlook

- Microplastic sampling is very complex
 - ➔ New methods of sample taking were developed
- Sampling and analytics is not standardised
 - ➔ FTIR □ Number of particles and material
 - ➔ TGA/GCMS □ Mass of particles and material
- Road run off and stormwater overflows → important impact
- Reduction of tyre wear emission for example:
 - ➔ Labelling TWP emission, alternative tyre materials
 - ➔ Speed and acceleration limitation in urban areas
 - ➔ Promote public transport and bicycle traffic
 - ➔ Treatment at emission hotspots, Improve road cleaning
- Wastewater treatment plants (WTP)
 - ➔ Microplastic removal >> 95% - 99%
 - ➔ Effluents of WTP have a minor impact on MP emission
- Are regulations necessary?