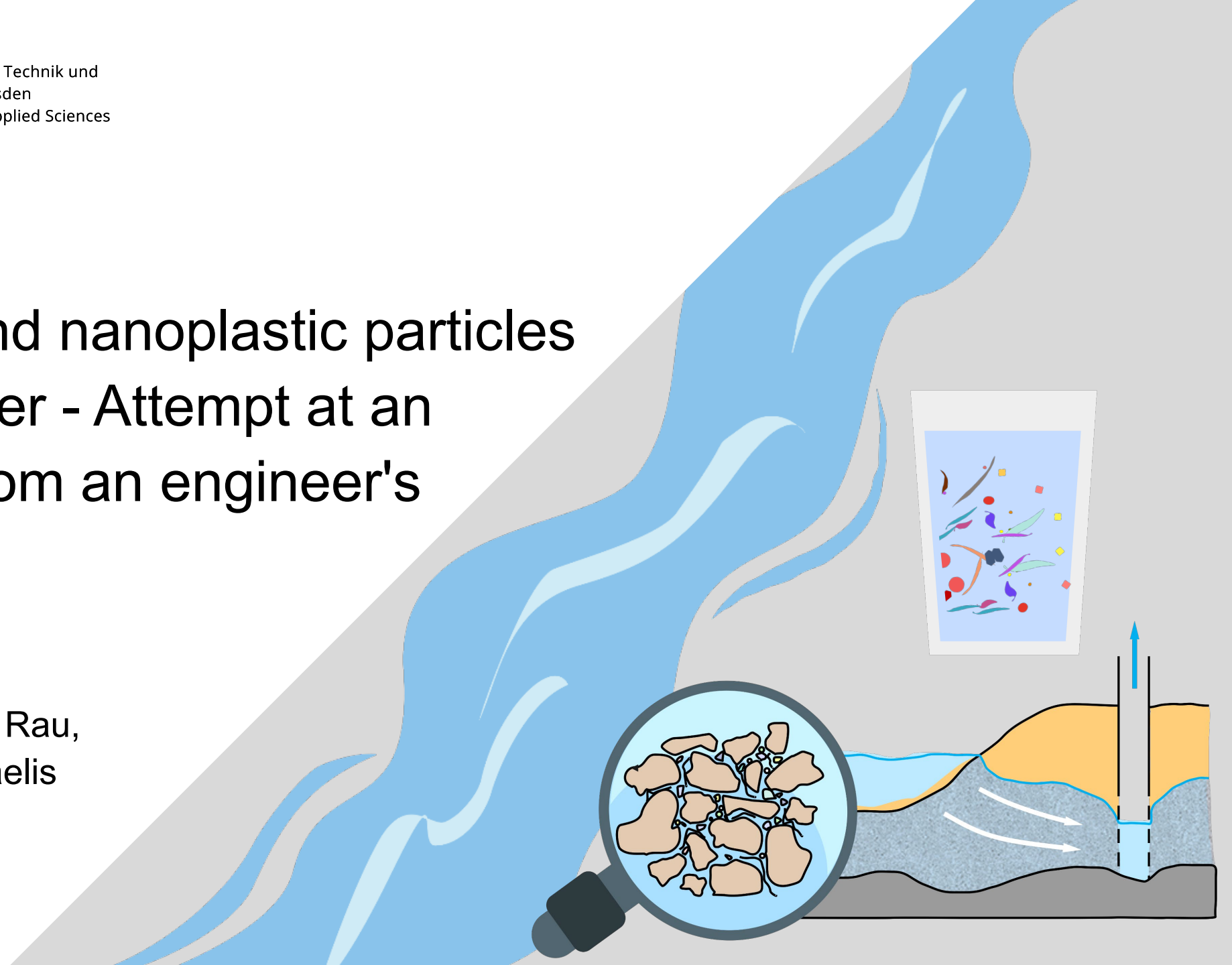


Microplastic and nanoplastic particles in drinking water - Attempt at an assessment from an engineer's perspective

T. Grischek, J. Ding, C. Rau,
L. Landmann, M. Michaelis

10.04.2026

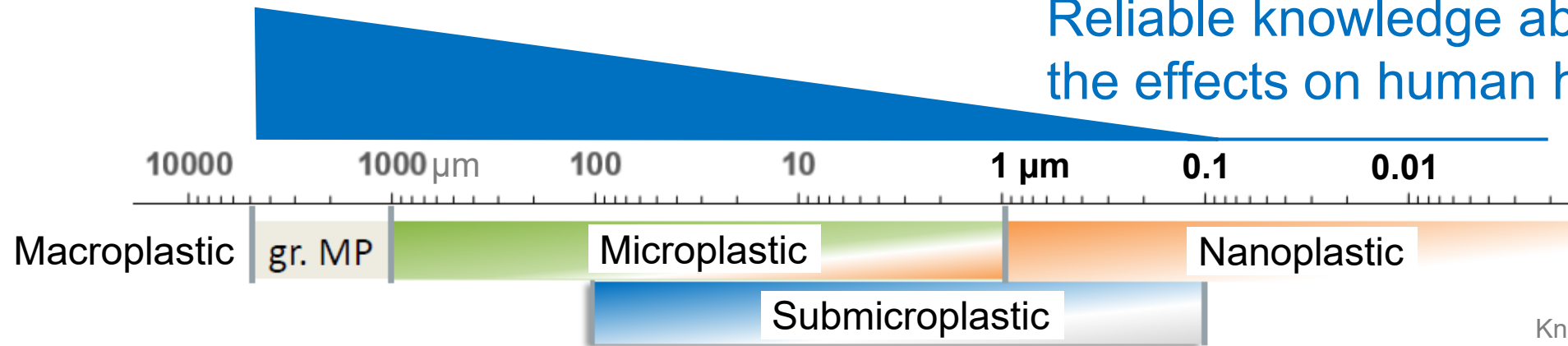


Outline

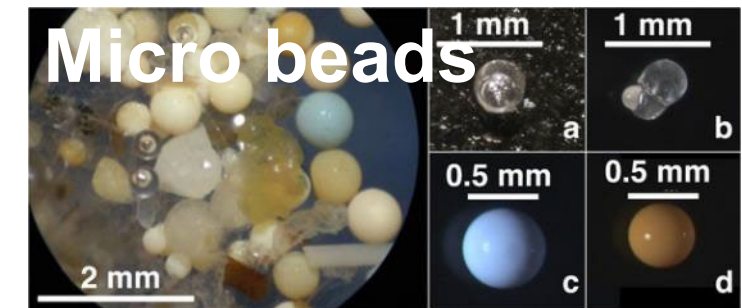
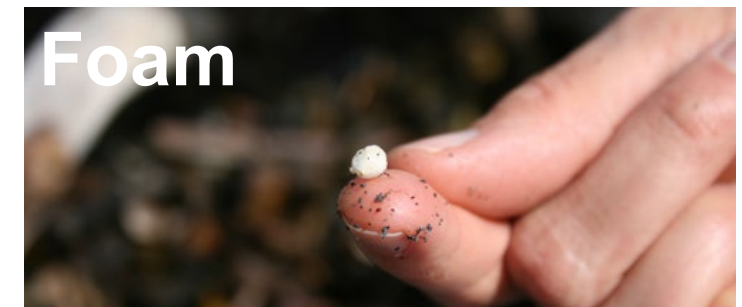
- // Definition and sources of micro- and nanoplastics
- // What is HTWD doing in the field of microplastics?
- // Environmental sample preparation and analysis
- // MP in groundwater, drinking water and mineral water
- // How MP affects biota / humans?
- // Attempt at an assessment

Definition and types of microplastics (MP)

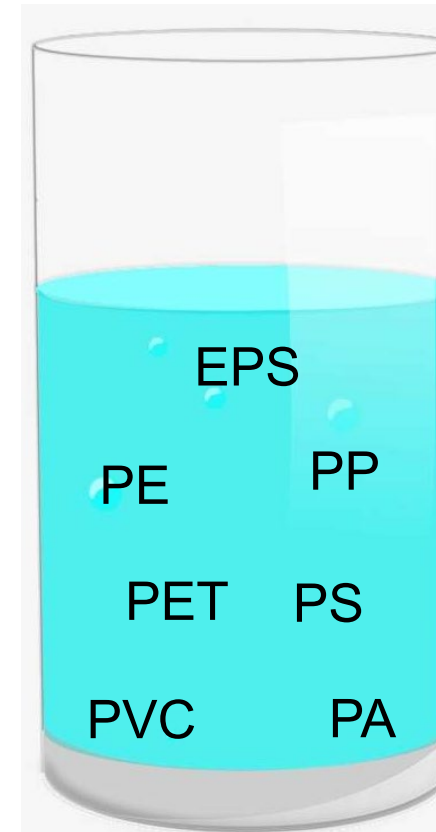
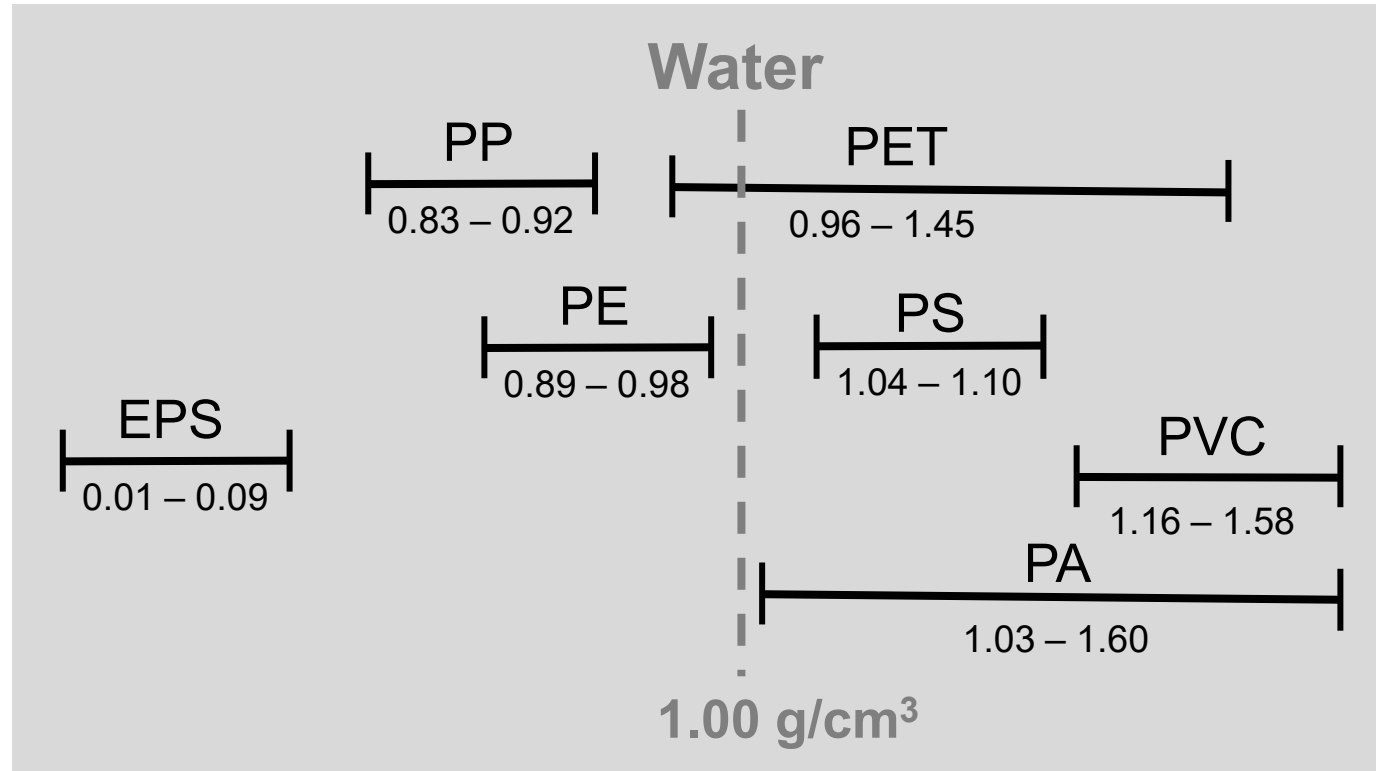
Reliable knowledge about the effects on human health



Knoop & Drewes (2021)



Density of polymers

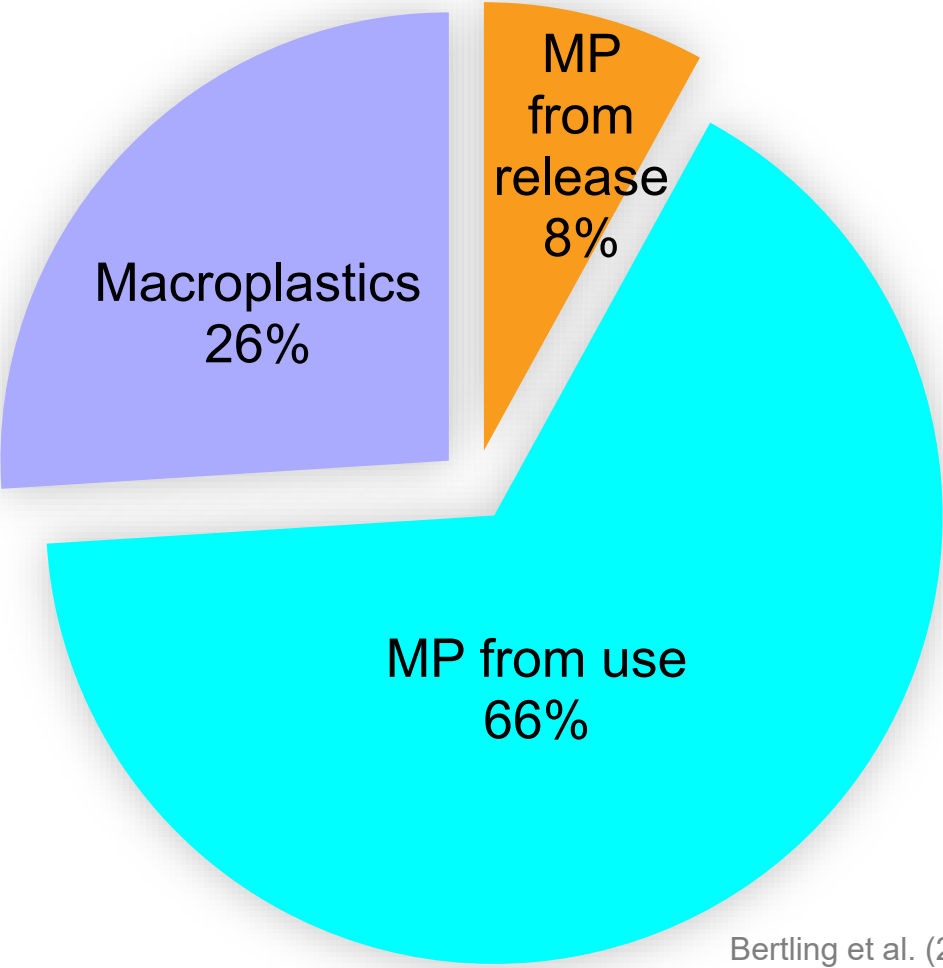
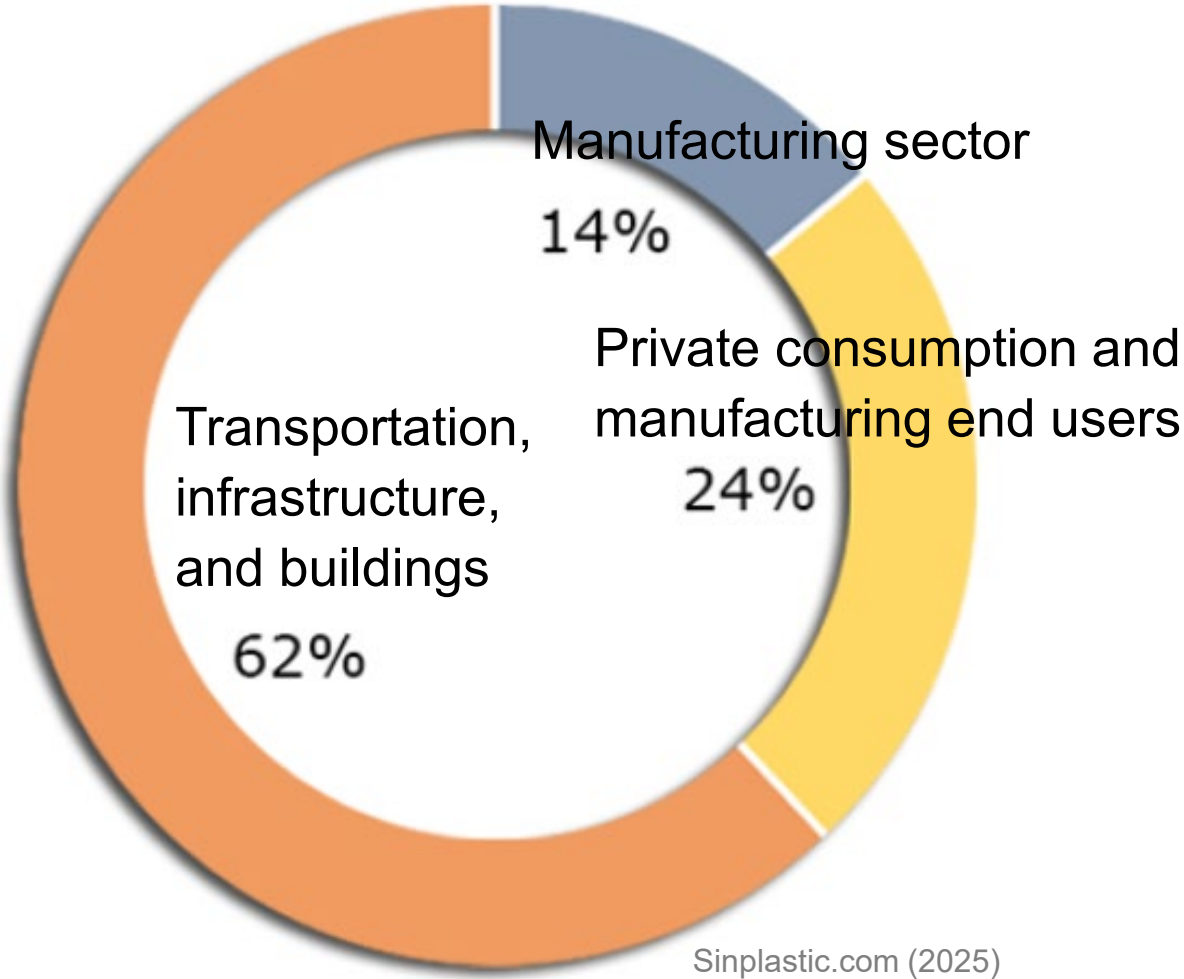


- PP – polypropylene
- PET – polyethylene terephthalate
- PE – polyethylene
- PS – polystyrene
- EPS – expanded polystyrene
- PVC – polyvinyl chloride
- PA – polyamide

- Caution: Sinking of lower density MP due to
 - Formation of biofilms on particles
 - Aggregation of suspended solids, enclosure

Sources of microplastics

Percentage share of microplastic emissions in Germany



Microplastic emission per person per year in Germany

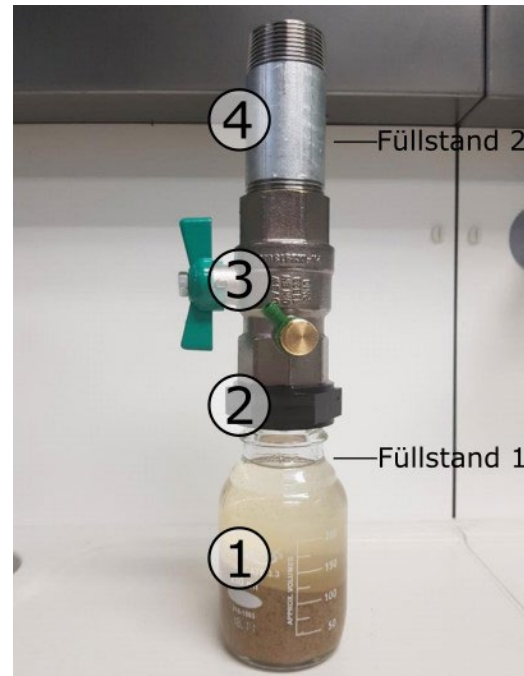


Fraunhofer UMSICHT 2018; eigene Darstellung

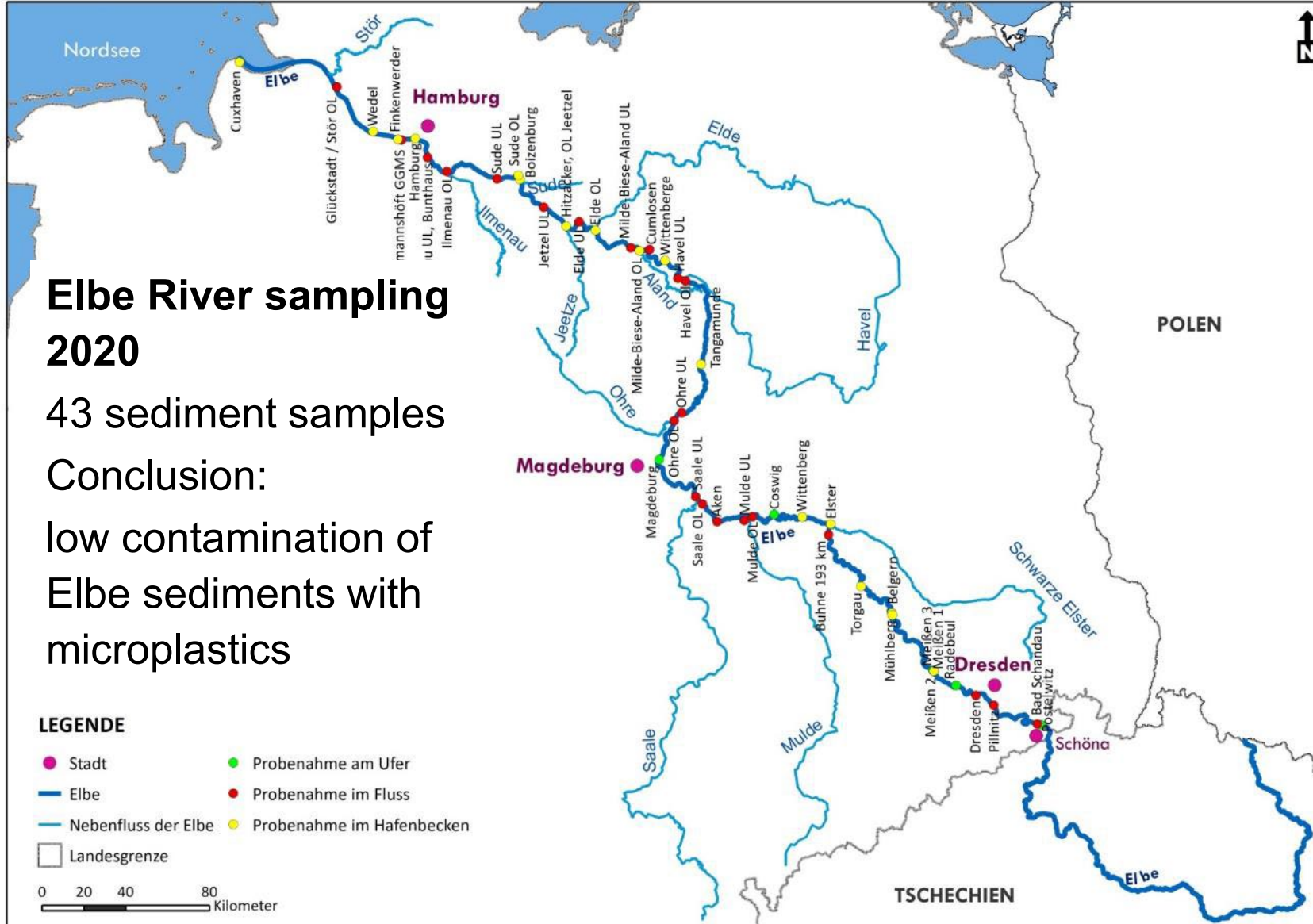
What is HTWD doing in the field of microplastics?

ESF project VEMIWA 2020-2022

- // Development of separation techniques: electro-separation, density separation
- // Use of differential scanning calorimetry for cost-effective detection of MP
- // Testing sampling techniques, laboratory and field experiments on the behavior of MP in water



Sampling of Elbe riverbed sediments in 2020



Electro separation
 + density separation
 + differential thermal analysis

→ Identification of PE, PP, PA

max 0.28 ± 0.20 mg/kg PE

Cost >600 €/sample

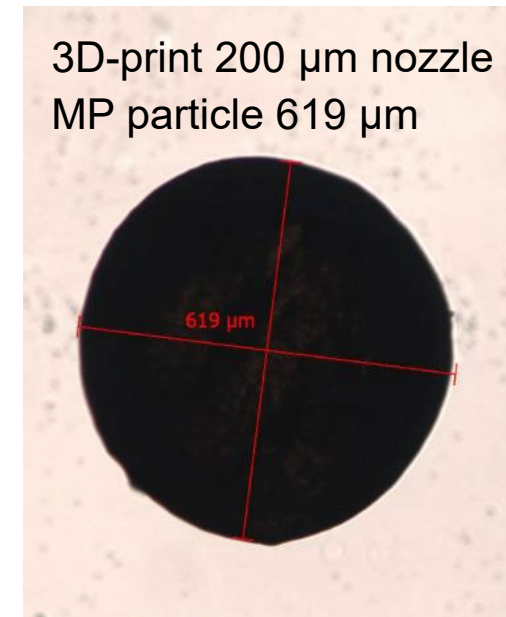
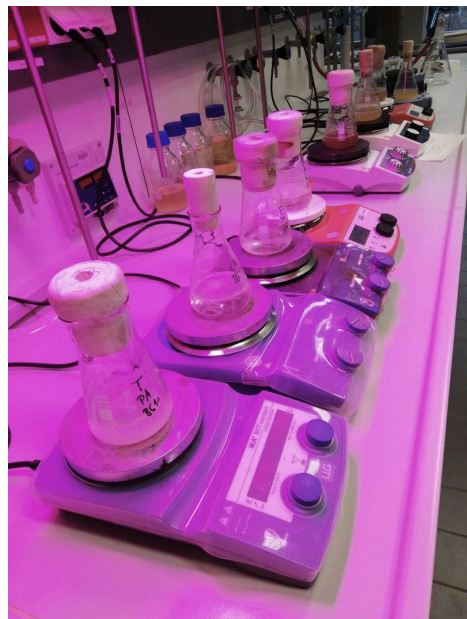
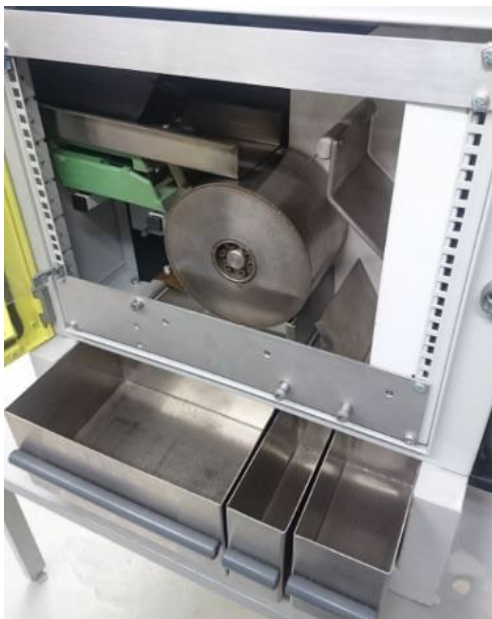
Time for analysis >100 hrs

HTWD (2020)

What is HTWD doing in the field of microplastics?

ESF project SEMUWA 2023-2025

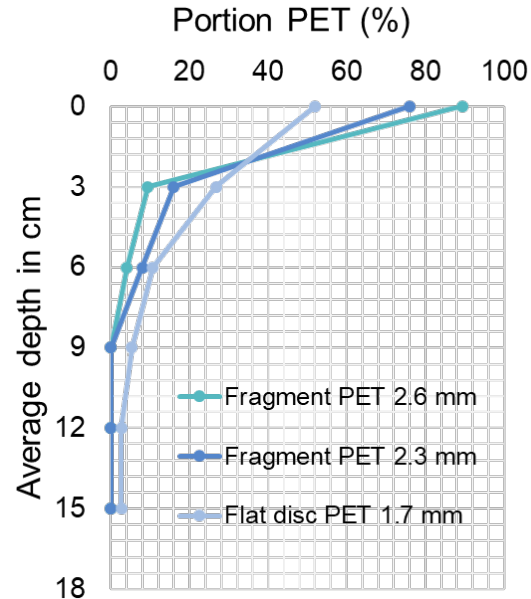
- // Polymer-specific electro-separation, density separation with oleic acid, etc.
- // Optimization of differential calorimetry, comparison with IR microscopy
- // Production of MP reference particles using 3D printing
- // Analysis of water and sludge from waterworks, efficiency of coagulation, flotation



Column experiments on the transport of MP in aquifers

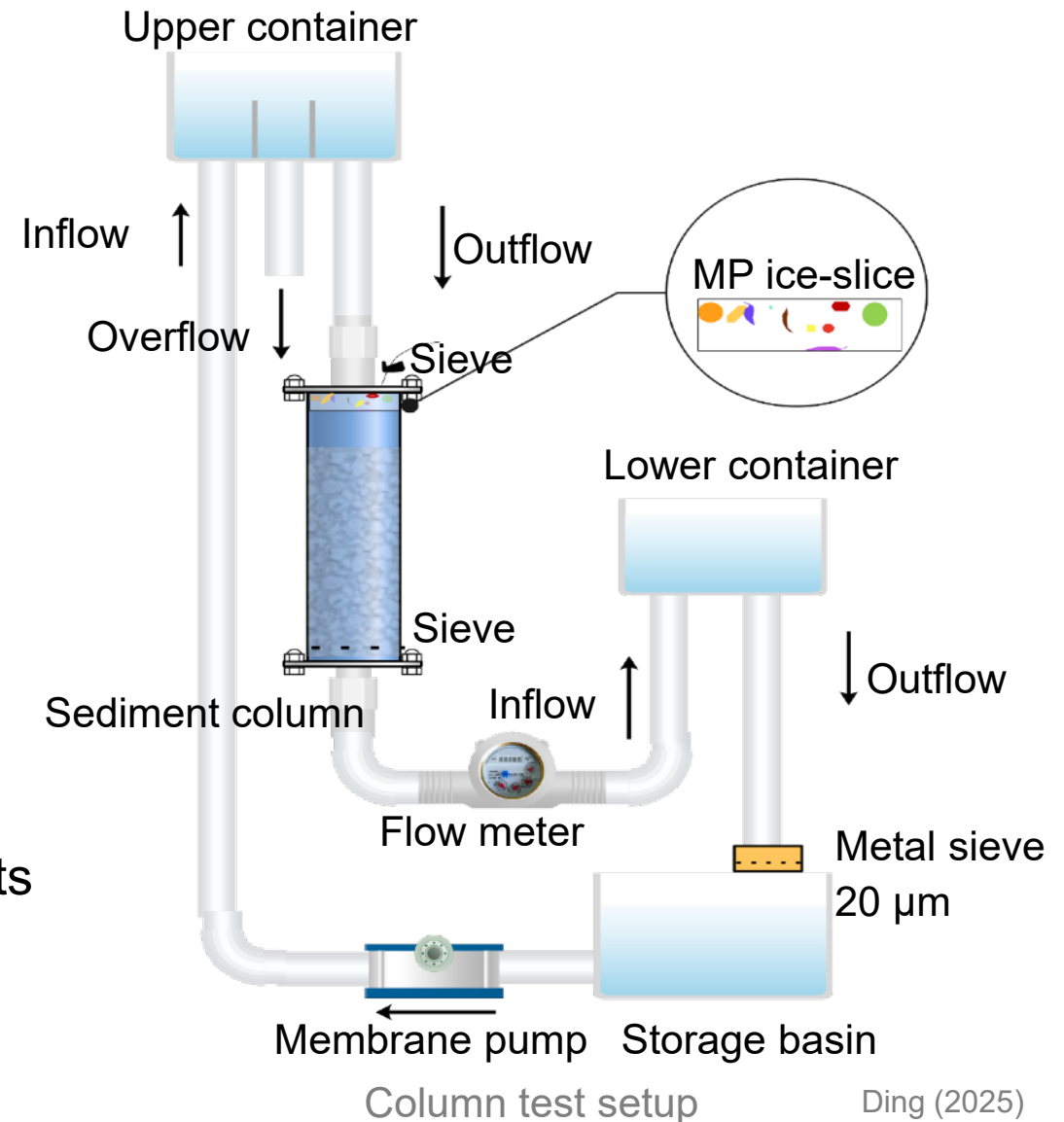
Polymers: PET, PA, HDPE, LDPE

Particle size: 800 μm – 3 mm, 63 – 800 μm

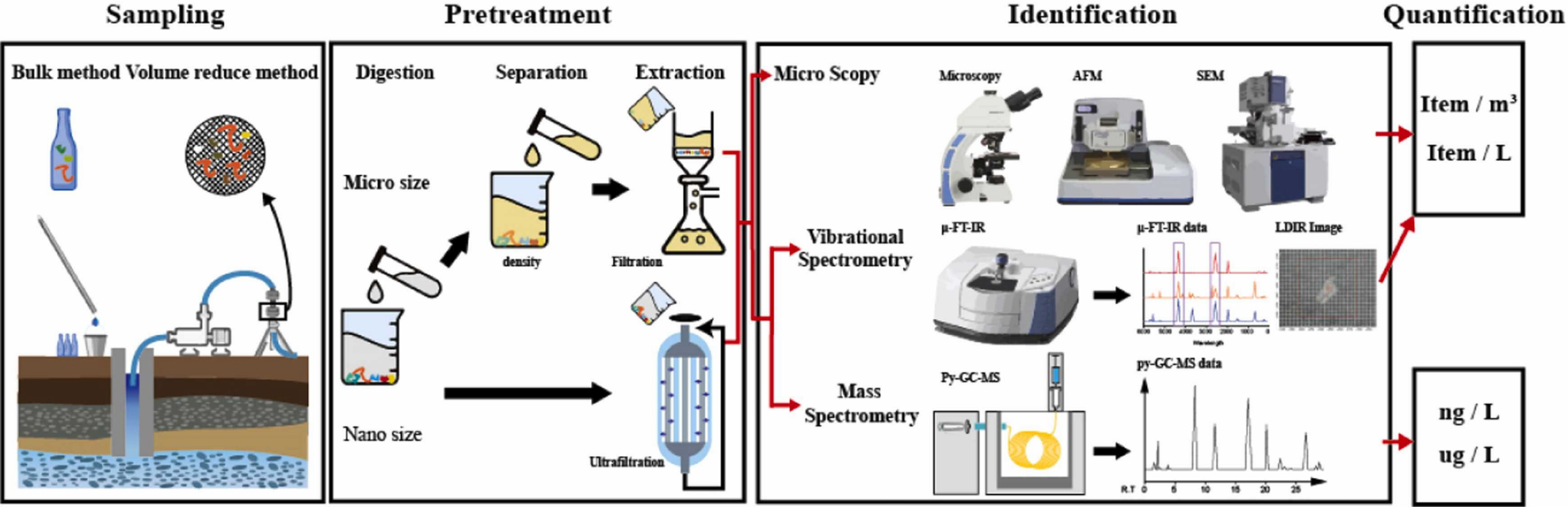


Smaller and heavier particles penetrate deeper

Infiltration depth: Fibres > Spheres > Pellets > Fragments



Quantification of MNP in environmental samples



Jeon & Kim (2024)

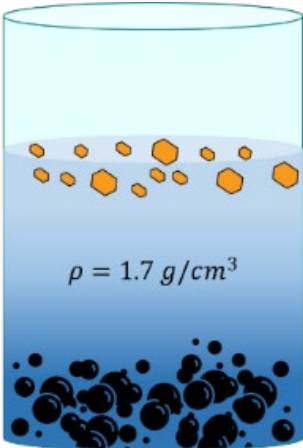
Sample preparation for environmental samples at HTWD

Which method?



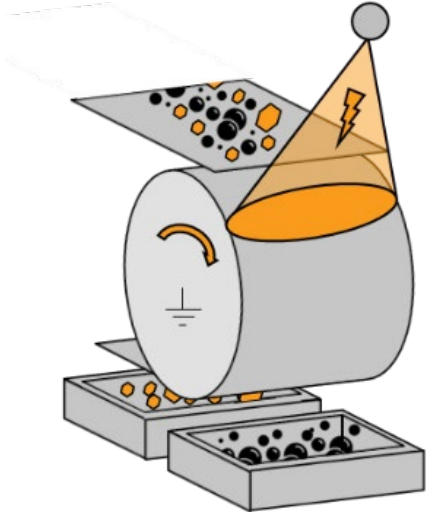
Quelle: Reddit.com, u/Plokon100, 03.07.2022

Density separation



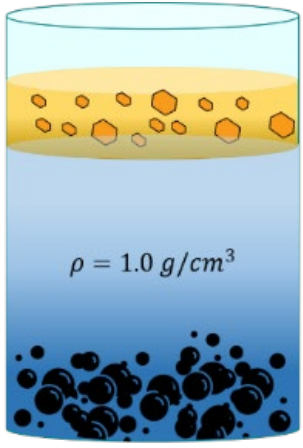
Density difference

Electro-separation



Electrostatic properties

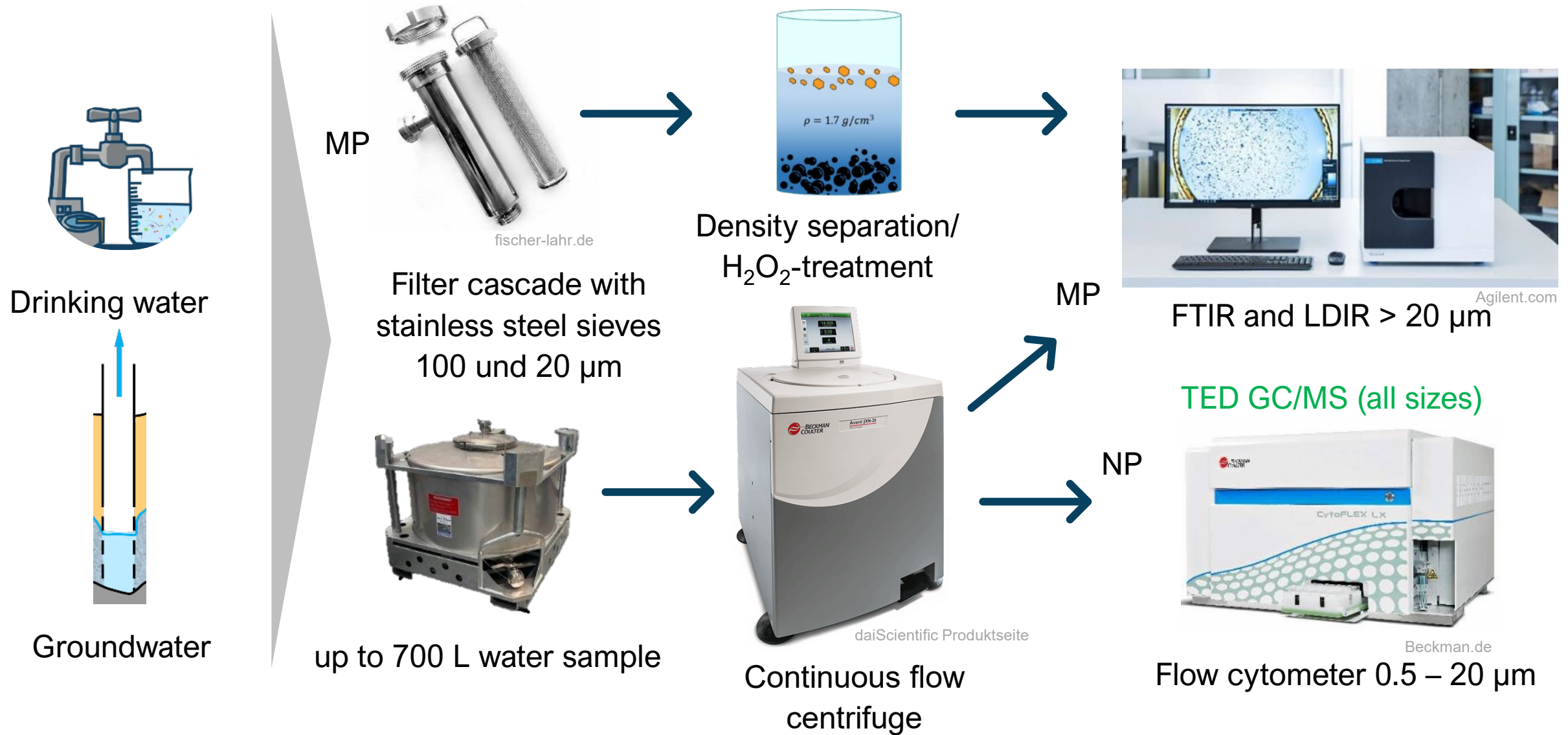
Oil separation



Surface properties

Separation principle

Analysis of microplastics in drinking water at HTWD



Detection of MNP 0.5 – 20 μm using flow cytometry



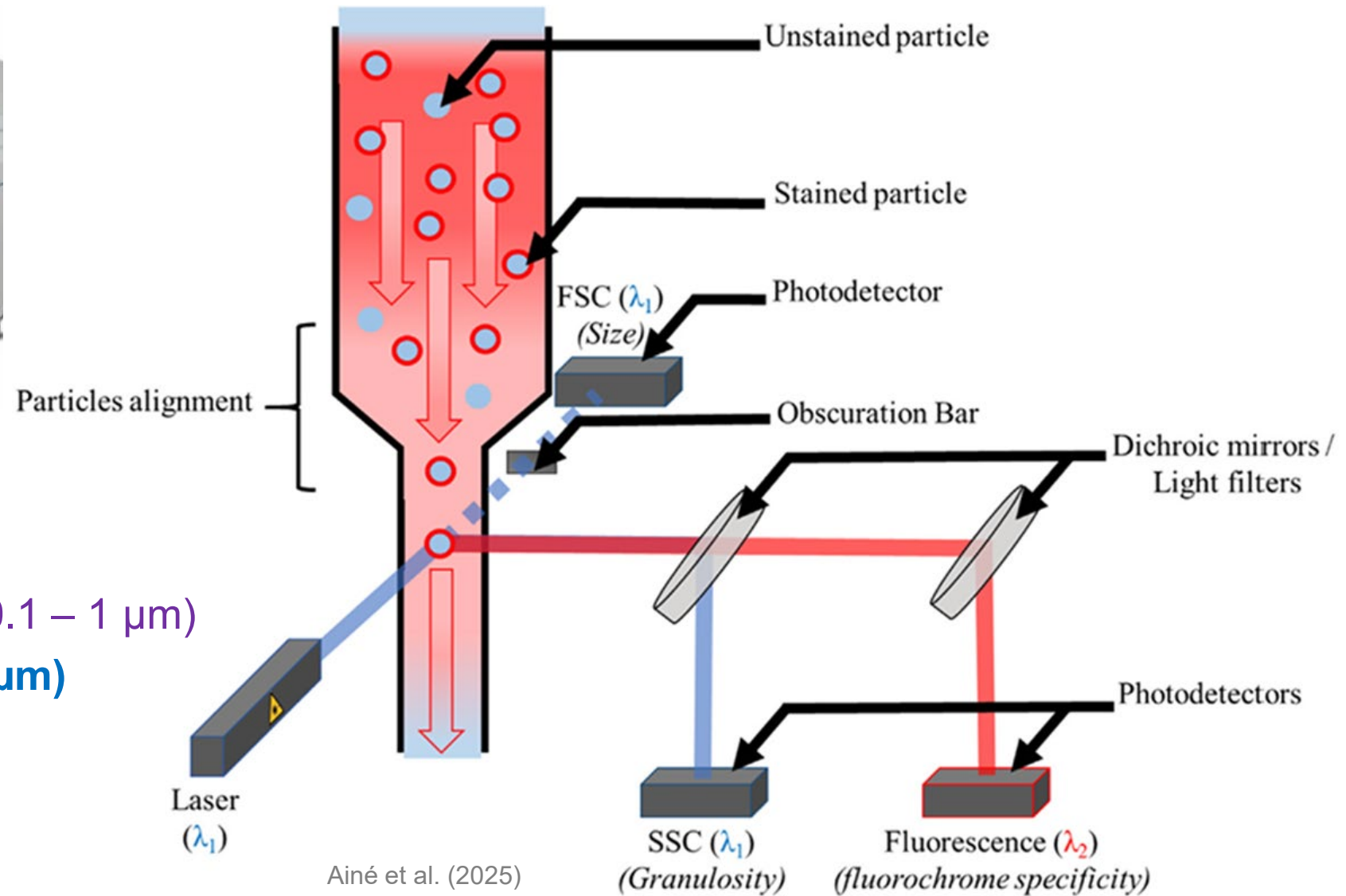
Cytoflex from Beckman

Laser:

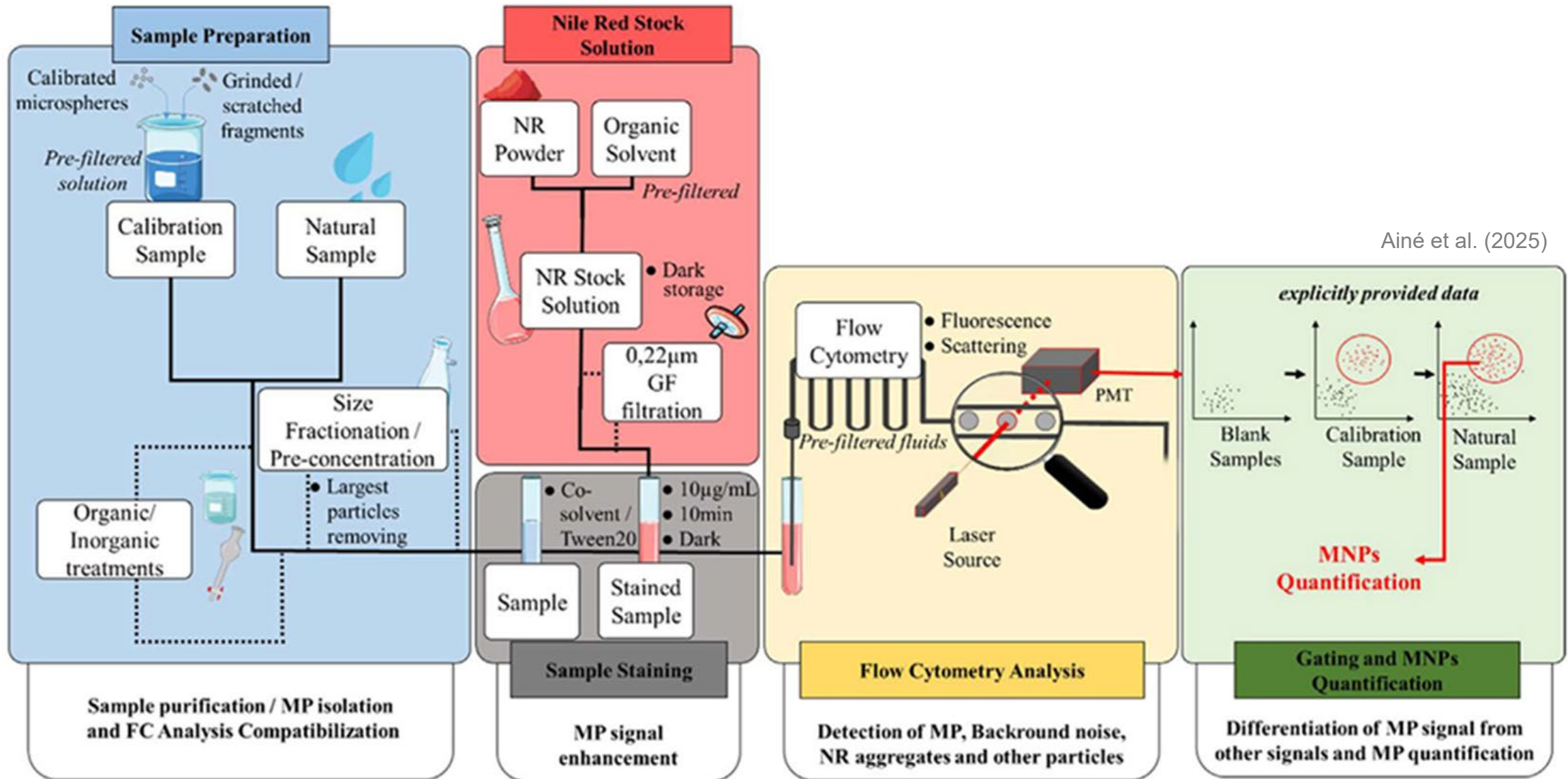
405 nm (will be used later for 0.1 – 1 μm)

488 nm (applied for 0.5 – 20 μm)

638 nm

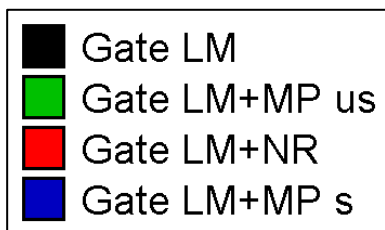
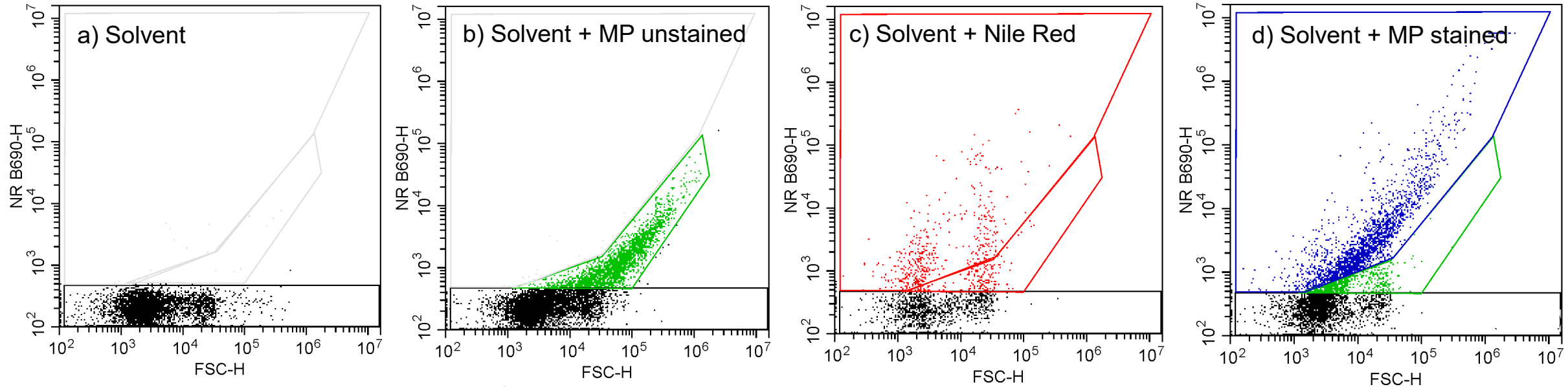


Detection of MNP 0.5 – 20 μm using flow cytometry



Example: Detection of LD-PE 0.6 – 20 μm using flow cytometry

Gating for MP LD-PE 0.6 – 20 μm (MP) stained using Nile Red (NR) after 10 min in 60% DMSO



Recovery for LD-PE only 74% (aim to achieve 90%)

Different gates for different polymers

Risk of overestimation due to agglomeration of fluorescent dye

Measurement time for 1 sample ~40 min

Relatively low cost of consumables

Michaelis (2026)

Detection of MP using Laser Direct Infrared (LDIR) Imaging, FTIR and TED-GC/MS



Agilent 8700 Laser Direct Infrared (LDIR) Chemical Imaging System



Agilent.com (2026)

- Quantum cascade laser + thermoelectrically cooled detectors eliminate the need for liquid nitrogen → low cost for consumables
- Probably lower sensitivity than μ FTIR
- No autosampler but holder for 2 filters
- Measurement time for 1 sample 20 – 30 min depending on number of particles
- Database needs to be enlarged

TED-GC/MS: Thermal Extraction-Desorption Gas Chromatography-Mass Spectrometry

- Higher mass of sample, less matrix problems
- System more complex (2 units coupled)

Microplastics in groundwater – Literature data

// Mainly PP and PE detected in groundwater

// Comparing the results is difficult due to different particle size ranges, sampling volumes, and hydraulic conductivity

Country	Sampling technique	Sample volume	Particles / L	Polymers	Particle size	Analytics	Reference
Germany	not specified	300 – 1000 L	< 0.002	PE	> 20 µm	FTIR	Mintenig et al. 2019
Poland	not specified	20 – 100 L	1.3 ± 2.1	PU, PA	> 50 µm	Raman Spectr.	Tarasewicz et al. 2025
South Korea	peristaltic pump	100 – 500 L	0 – 0.56* 0.04 – 17.77**	PP, PET, PVC, PA	> 20 µm	FTIR	Cha et al. 2024
South Korea	peristaltic pump	500 L	0.006 – 0.192	PP, PE, PET, PVC, PS	> 50 µm	FTIR	Kim et al. 2023
France	Supernova pump	8.8 – 10.2 L	0.71 – 106.7	PE, PP	> 25 µm	FTIR	Ledieu et al. 2023
Australia	stainless steel scoop	1 L	38 ± 8	PE, PP, PS, PVC	> 15 µm	LDIR	Samandra et al. 2022

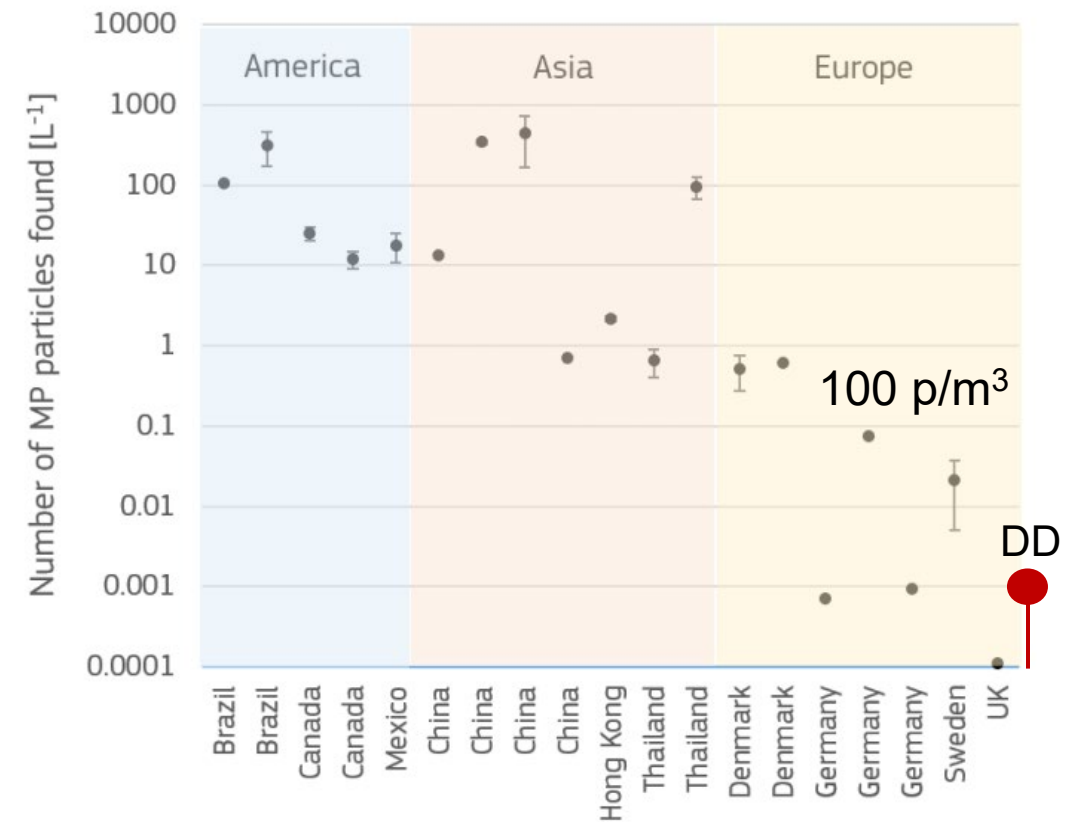
*dry season, **rainy season, FTIR - Fourier-Transformation-Infrared spectrometer, LDIR - Laser Direct Infrared Imaging

EU guideline for microplastic analysis in drinking water

Directive (EU) 2020/2184

of the European Parliament and of the Council of December 16, 2020 on the quality of water intended for human consumption

- Microplastics as an “emerging pollutant” in drinking water
- Development of a methodology for measuring microplastics in drinking water by January 12, 2024



Number of microplastic particles in drinking water
EU JRC analysis 2024

EU proposed method for sampling drinking water

Directive (EU) 2024/1441

of the Commission of March 11, 2024, supplementing Directive (EU) 2020/2184 by establishing a methodology for measuring microplastics in water intended for human consumption

// List of “priority polymers”: PE, PP, PET, PS, PVC, PA, PU, PMMA, PTFE, PC

// Sampling methodology

// Filter cascade with filters: 100 μm , 20 μm , also for process blind samples

// Direct filtration recommended (no intermediate containers, unless technically necessary)

// Minimum volume: 1000 liters of drinking water per sample

// **Target size: Microplastic particles (20 μm – 5 mm), fibers (20 μm – 15 mm)**

// Shape, size, composition: each particle type is categorized according to these three criteria

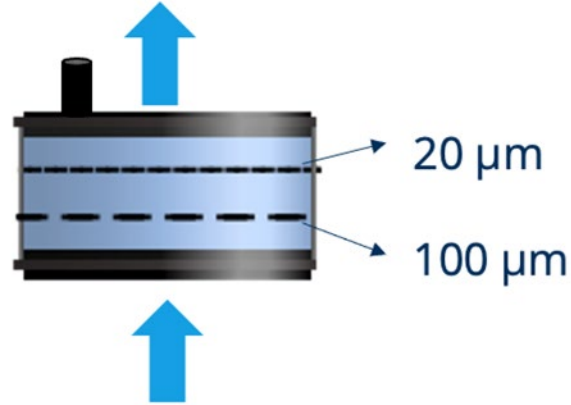
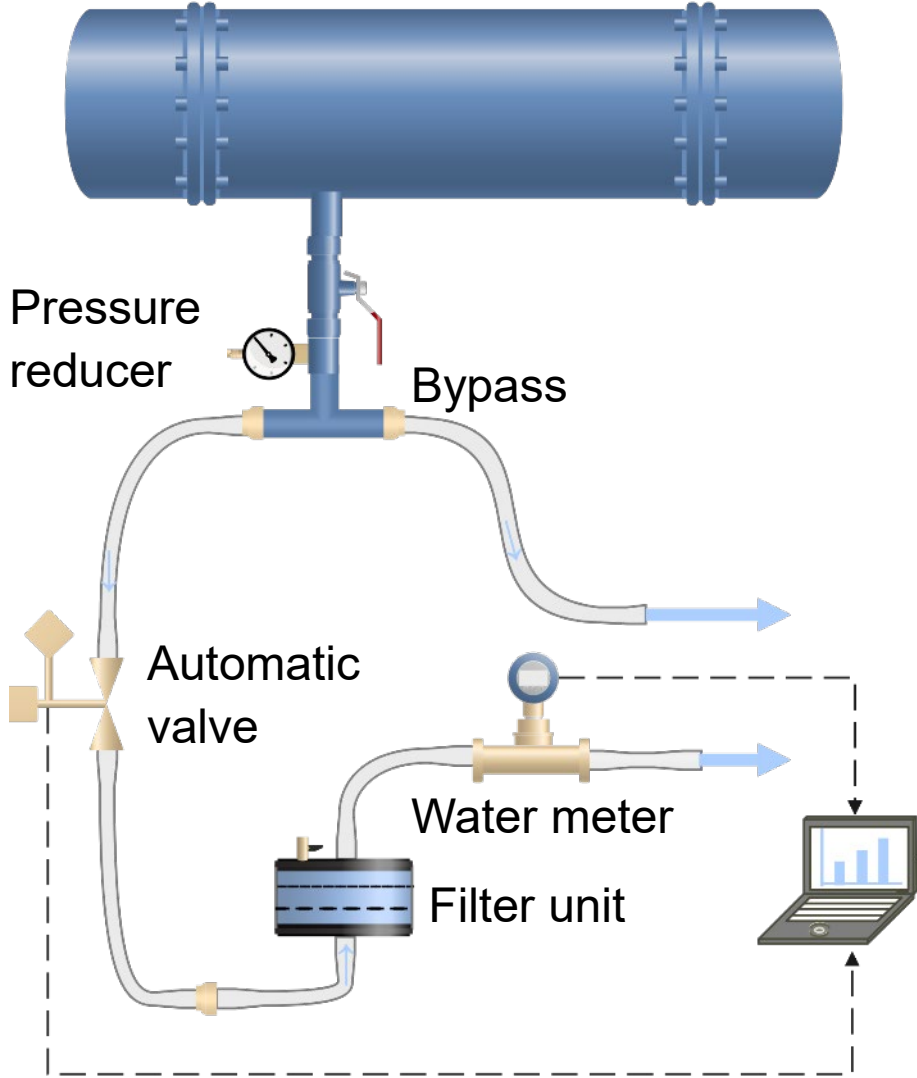
// Analysis

// Infrared-based methods: IR, μ -FTIR, QCL-IR

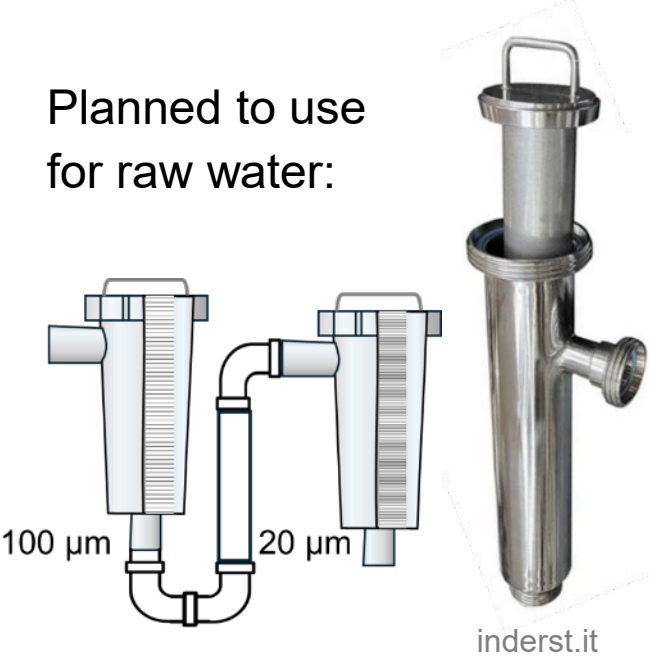
// Raman-based methods: (μ -)Raman-spectroscopy

// Vibrational spectroscopy

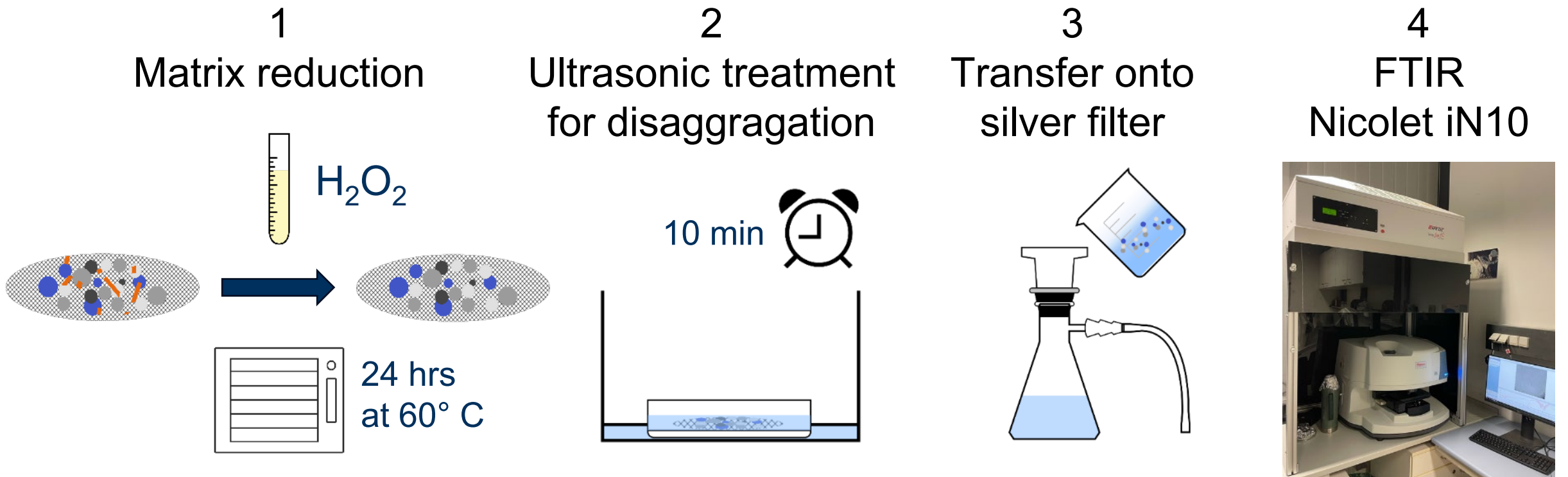
Drinking water sampling: 1000 L



Planned to use for raw water:



Sample treatment for MP detection in drinking water



First results from 2026:

- MP detected in only 3 out of 12 samples
- Max 5 particles/m³
- Average of positive samples 2 p/m³



No or very low contamination



Measurement time ~6 hrs/sample



Relatively high cost (nitrogen)



Risk

or

No Risk



Limited knowledge creates markets for filter systems and start-ups



Kein Bock auf kiloweise Plastik in Deinem Körper? Klar20 - die Lösung gegen Mikroplastik im Wasser!

Don't want pounds of plastic in your body?



Combating microplastics in drinking water:
Over one million euros for start-up "Klar20"

Wasserfilterkanne – MikroPLASTIK-STOP™

Art. UFSBE02

BESCHREIBUNG



www.laica.com

Die innovative MikroPLASTIK-STOP™-Kanne von LAICA ist die erste modulare Doppelfiltrationskanne zur Entfernung von Mikroplastik.

Dank der MikroPLASTIK-STOP™-Filterkanne können Sie und Ihre Familie das gute Leitungswasser ganz bequem zu Hause genießen. Der MikroPLASTIK-STOP™-Filter entfernt Schwebeteilchen wie Mikroplastik, die im Wasser enthalten sein können*.

riva

Shop

Trinkwasserfilter

Duschfilter

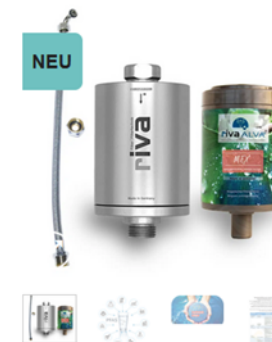
Wasserfilter Outdoor

Wasserwirbler

Ratgeber

riva-filter.de

Trinkwasserfilter Untertisch



rivaALVA MEX 2in1
Trinkwasserfilter | PFAS und Nanoplastikfilter

189,90 €

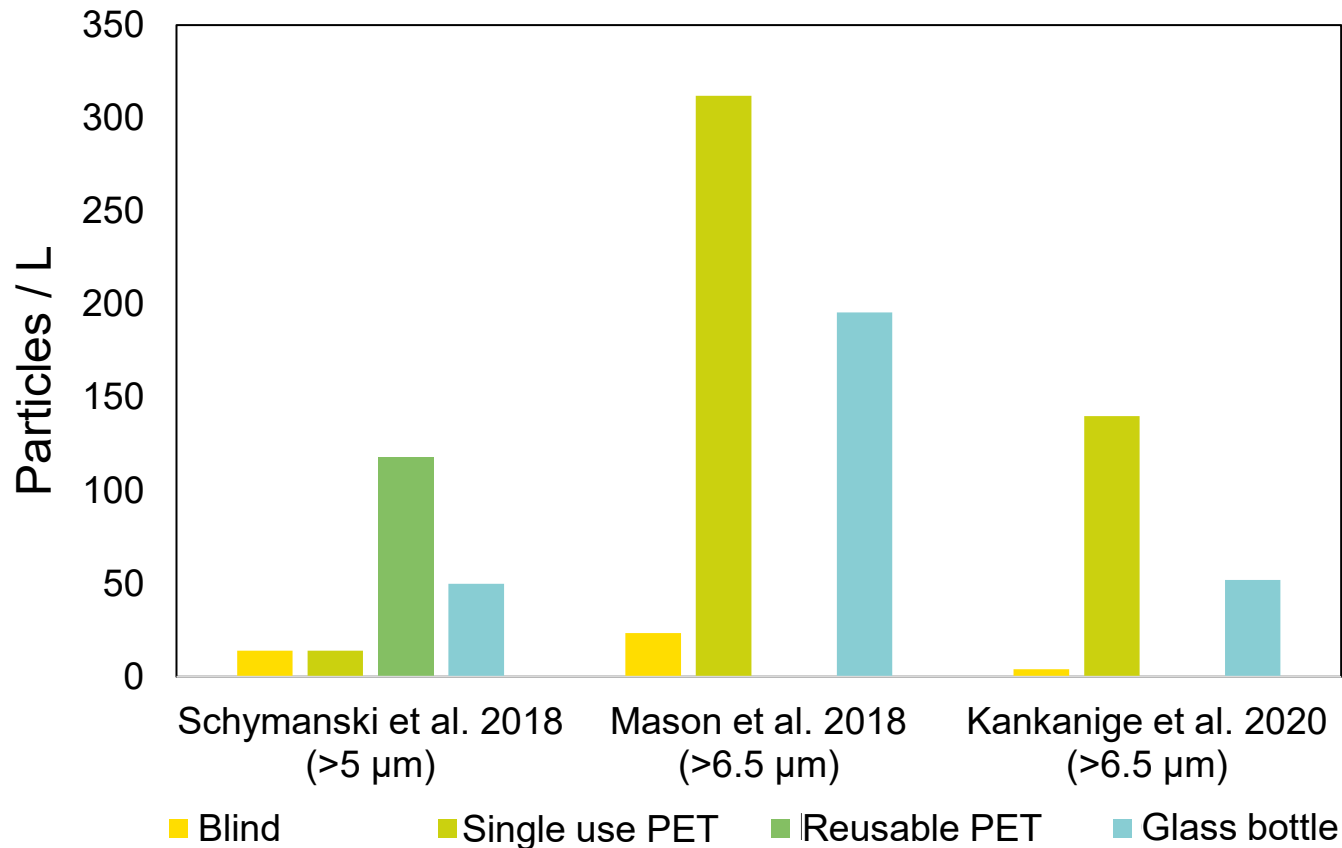
inkl. MwSt. Versandkostenfrei innerhalb Deutschland

- **FILTERT** 99 % PFAS
- **ENTFERNT** 99,9 % Mikro- und Nanoplastikpartikel
- **ZERTIFIZIERTE** Filterleistung durch verschiedene Labore >>

Should we drink bottled water?

More MP is usually detected in disposable bottles than in glass or reusable bottles.

Microplastics in bottled water (Oßmann 2021)



Very wide range of published results, partial contamination suspected in the laboratory

MP evidence in mineral water bottles worldwide: 1.4–10,000 particles/L

Kirstein et al. (2021)

Fun fact:

MP in a can of beer can: >800 particles/L

Jafari, B. (2026) eurofins, BSMAR19

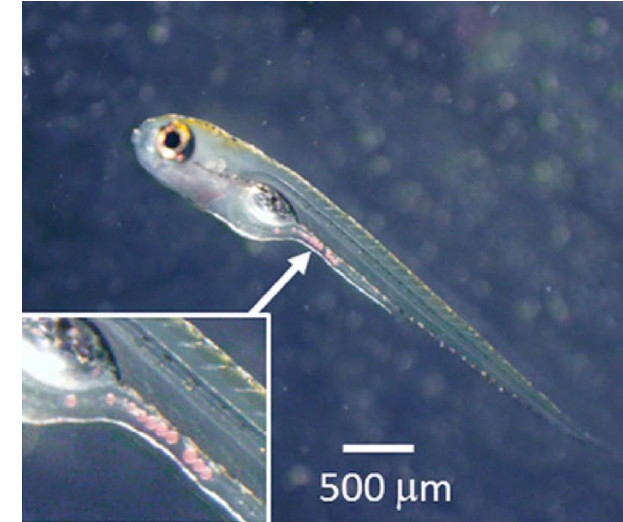
Compare:

Dresden drinking water 0.002 particles/L



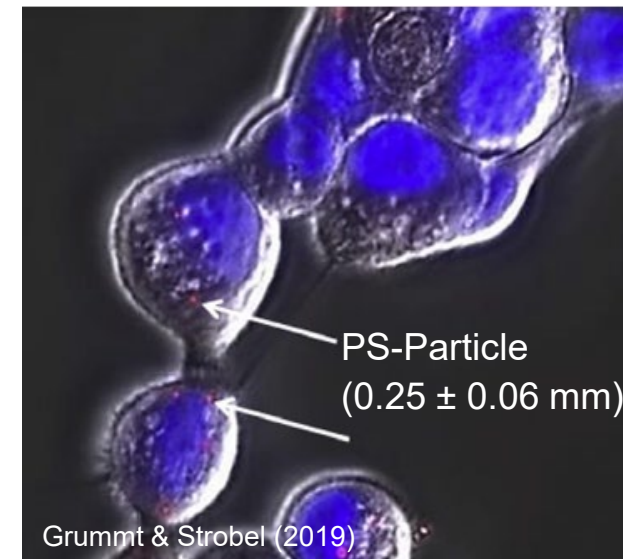
Risk or No Risk ?

Potential risks of MP ingestion



LeMoine et al. (2018)

- /// Ingestion of MP as food and introduction into the food chain
- /// Mechanical injuries to the digestive tract, malnutrition, oxidative stress
- /// Release/desorption of additives, pollutants, heavy metals
- /// Carrier for pathogenic bacteria and viruses



Grummt & Strobel (2019)

Critical aspects concerning risk assessment

- // Often limited documentation on sample preparation and prevention of cross-contamination
→ clean room conditions required
- // Detected MP >100 µm in groundwater/drinking water and animal cells – often not plausible looking at pore size and potential passage through cell membranes (see Triebkorn et al. 2019)
- // Lab experiments with e.g. fish often done with very high particle numbers, which are not observed in surface waters
- // Release of additives: Missing mass balances based on observed particle numbers in water/food
- // Carrier for pathogens: Many particles may act as carriers; recent finding in 1000 L drinking water: 3 MP particles out of about 1000 particles detected (FTIR, HTWD, 2026)
- // Missing blind and comparison tests – Would zebrafish get depressive too if there is a high number of mineral particles?
- // Mixing observations and prove of effects – e.g. high MP numbers in brains of Alzheimer patients

How does nanoplastics affect humans?

nature medicine

2025

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Research Briefing | Published: 24 February 2025

Nanoplastics in the human brain and their change in abundance over time

[Nature Medicine](#) (2025) | [Cite this article](#)









Science of The Total Environment

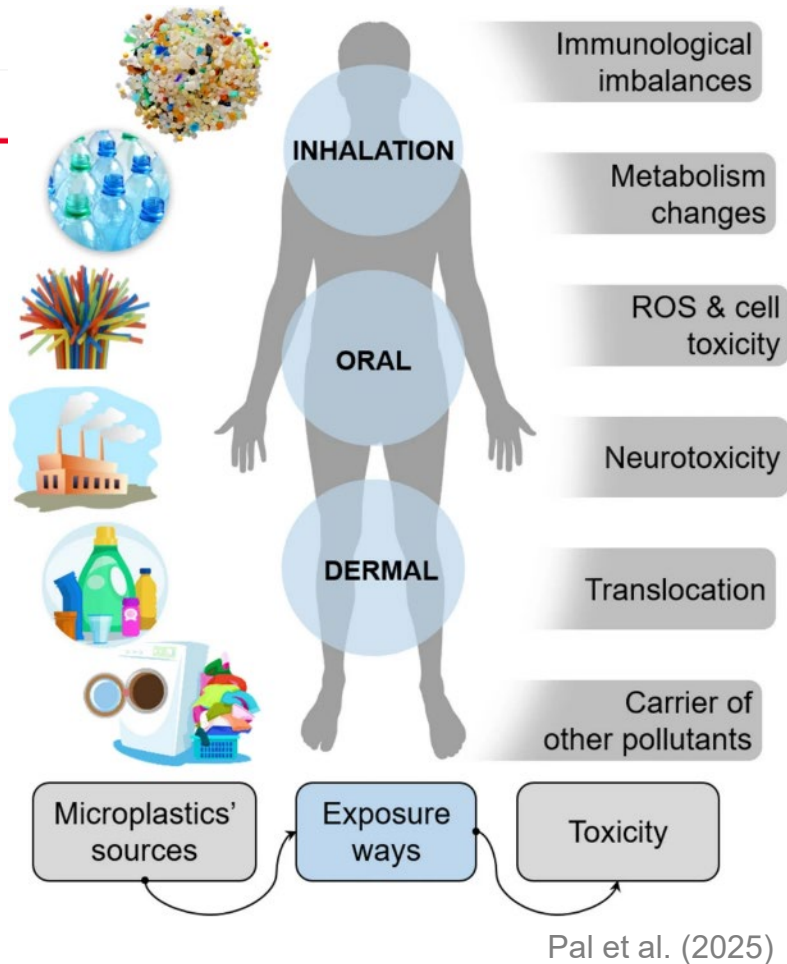
Volume 838, Part 2, 10 September 2022, 155811

2022



Distinct accumulation of nanoplastics in human intestinal organoids

Zongkun Hou ^a, Run Meng ^a, Ganghua Chen ^a, Tangmin Lai ^a, Rui Qing ^b, Shilei Hao ^a  ,
Jia Deng ^c  , Bochu Wang ^a  



ACS NANO

2025

www.acsnano.org

Polystyrene Nanoplastics Hitch-Hike the Gut–Brain Axis to Exacerbate Parkinson’s Pathology

Xiufang Liang, Gangtong Huang, Yue Wang, Nicholas Andrikopoulos, Huayuan Tang, Feng Ding,^{*} Yuhuan Li,^{*} and Pu Chun Ke^{*}

 Cite This: *ACS Nano* 2025, 19, 5475–5492

 Read Online




2025



Review

Micro- and Nano-Plastic-Induced Adverse Health Effects on Lungs and Kidneys Linked to Oxidative Stress and Inflammation

Seung Eun Lee ¹, Do Yun Kim ², Taek Seung Jeong ² and Yong Seek Park ^{1,*} 

How does nanoplastics affect humans?

naturemedicine

2025

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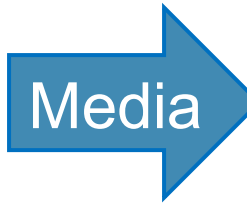
Research Briefing | Published: 24 February 2025

Nanoplastics in the human brain and their change in abundance over time

[Nature Medicine](#) (2025) | [Cite this article](#)

Direct quote from the publication:

“The present data suggest a trend of increasing MNP concentrations in the brain and liver. ... MNP concentrations in normal decedent brain samples were 7–30 times greater than the concentrations seen in livers or kidneys, **and brain samples from dementia cases exhibited even greater MNP presence. These data are associative and do not establish a causal role for such particles affecting health.**” Nihart et al. 2025

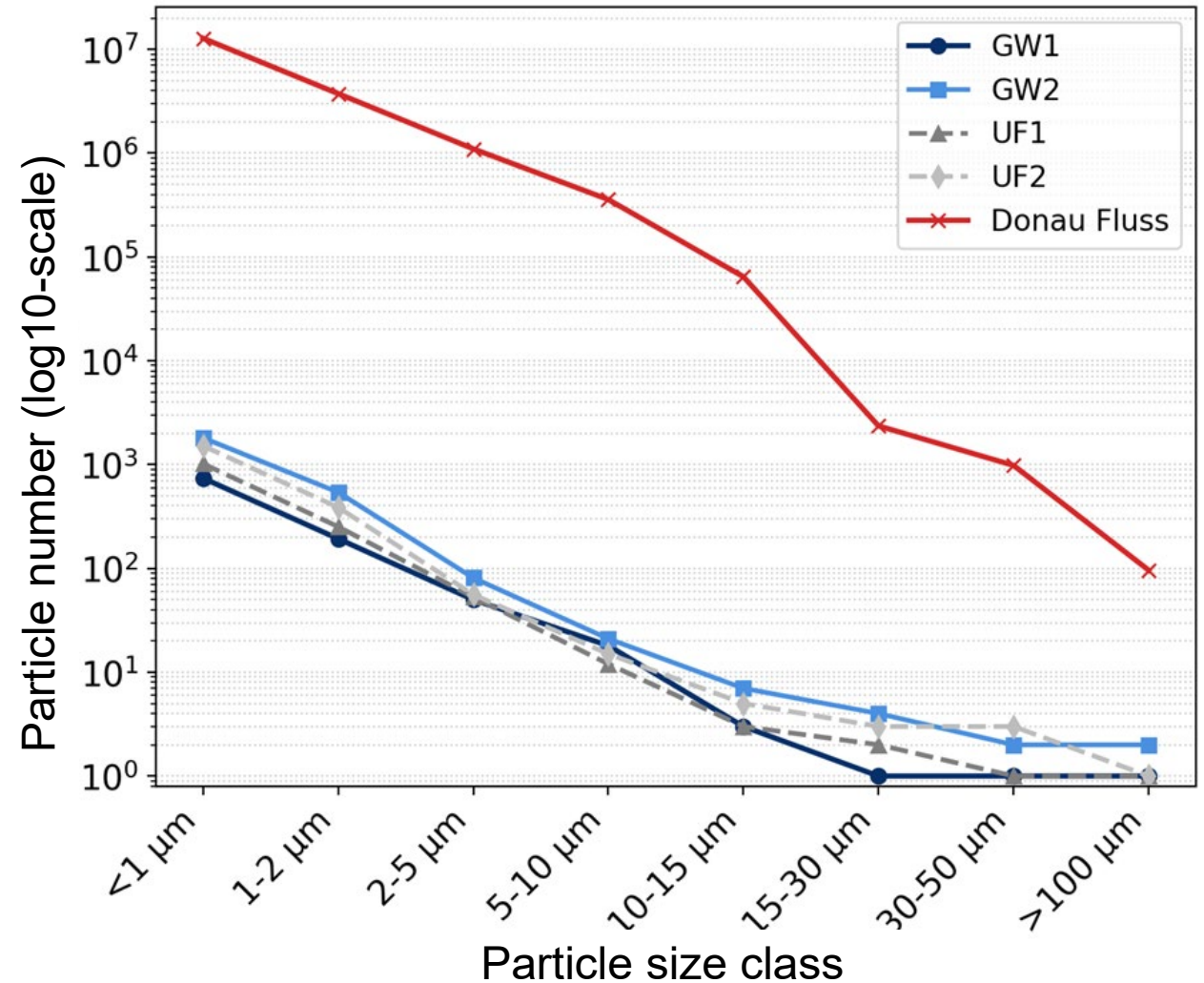


©plasticpollutes

Early case study: Higher number of smaller particles



- Groundwater well near Danube River
- Nylonfilter with pore size 500, 300, 150, 100, 50, 30, 15 und 5 μm
- Density separation, FTIR-detection

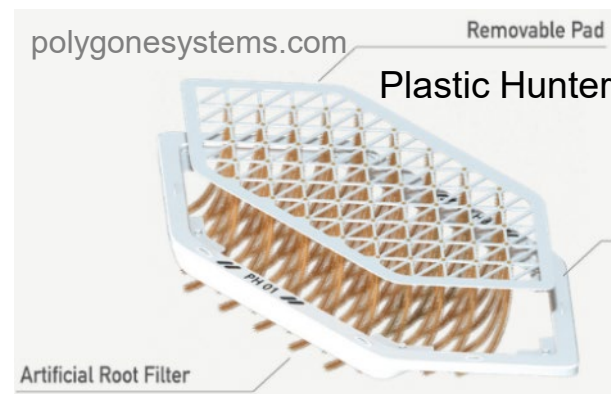
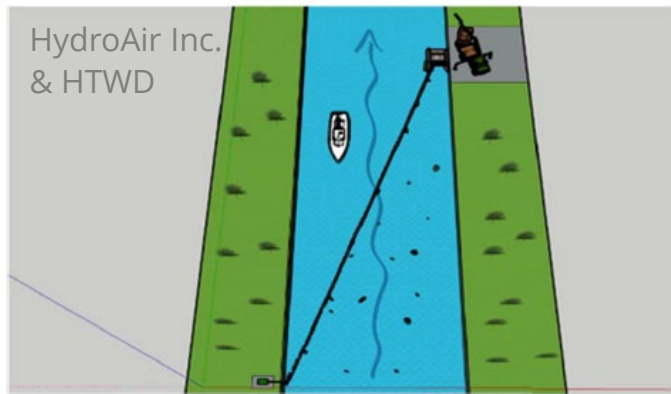


Vymetal (2016)

What can we do?

// Use of biodegradable plastics? → Only partially degradable, expensive, 2025: <1%

// Water purification? → Process not yet fully developed



// Avoiding the use of plastics → Potential in products and packaging

// Proper disposal, waste prevention → Focus on macroplastics



WWF (2020)

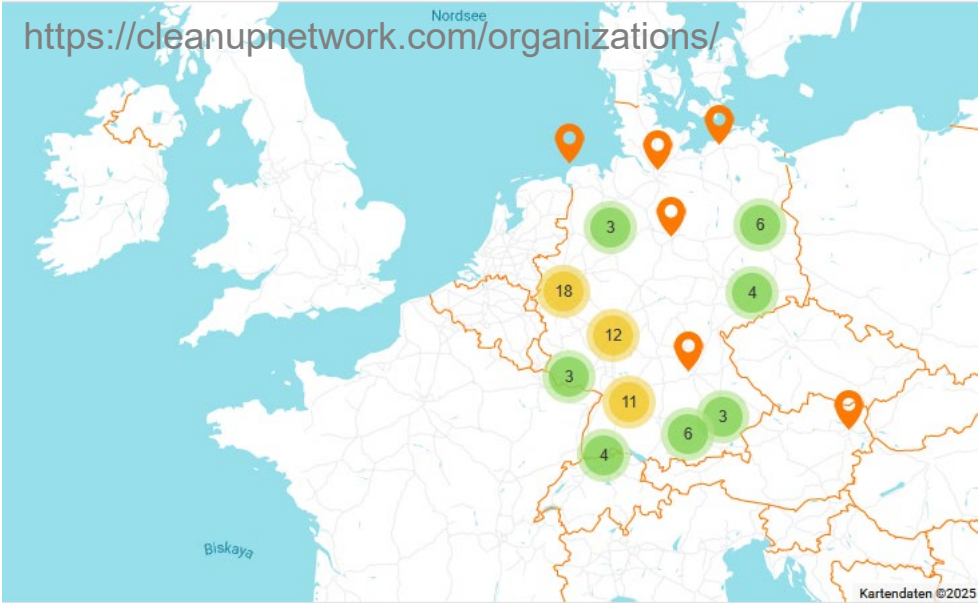
Macroplastics become microplastics



Study 2022-2024

Floating debris >1 cm in the Rhine River

Gnann et al. (2026)



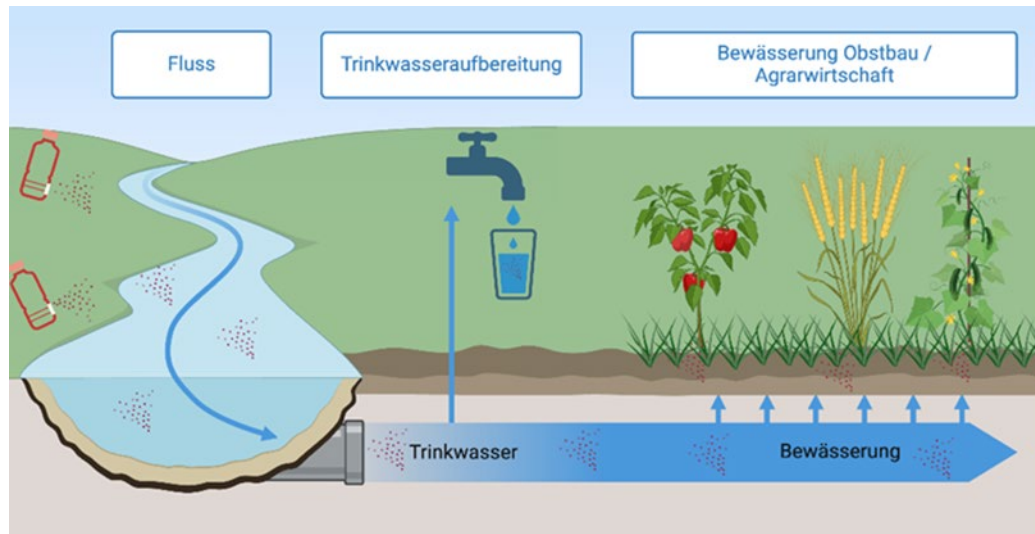
Kluge, sächsische.de (2019)

Garbage collection campaigns have an effect!

Conclusion

- // **Data basis is insufficient for a reliable assessment → applies to all waters and drinking water**
- // Contamination of riverbed sediments in the Elbe and smaller rivers in Saxony was found to be lower than expected, subject to current detection limits; random samples showed low contamination
- // Development of standard methods for the enrichment and analysis of MNP is necessary
- // EU methodology proposal for drinking water analysis focuses on particles $>20 \mu\text{m}$
- // Handling / preparation of water samples is tricky, needs clean room conditions
- // Risk of MP ingestion often overestimated
- // **Risk assessment of NP in water and food needs methodological developments, NP not covered by new EU drinking water guideline**
- // **We need fact-based scientific communication, not media scaremongering**

Potential research cooperation



ESF Young Researcher Group “NALEWA – Detection and intake of nanoplastics via food and drinking water”
11/2025 – 10/2028, 5 PhD students, 1 PostDoc

- // Development of standard methods for the enrichment and analysis of MNP
- // Characterization of biofilms and surface charge; MNP degradation studies; MNP removal during drinking water treatment
- // MNP standards produced by HTWD; exchange of samples, testing FCM / LDIR method in Dresden
- // Detection of tire wear particles using LDIR
- // Exchange of students and researchers

Contact / Acknowledgement / Publications

Prof. Dr.-Ing. Thomas Grischek, Lehrgebiet Wasserwesen, Ph. +49 351 4623350, thomas.grischek@htw-dresden.de

HTW Dresden, Friedrich-List-Platz 1, 01069 Dresden, www.htw-dresden.de/luc/forschung/mikroplastik

Thanks to ESF, SAB, SMWK, and SMEKUL/SMUL for funding the research work.



Kofinanziert von der
Europäischen Union



Diese Maßnahme wird mitfinanziert durch
Steuermittel auf der Grundlage des vom
Sächsischen Landtag beschlossenen Haushaltes.



Saxony⁵

Publications

Adomat, Y., Ding, J., Hofmann, M., Schubert, L., Grischek, T. (2026) Flume experiments on transport and deposition behavior of microplastics in sediment bed environments. *Sci. Tot. Environ.* 1027, 181708. doi:10.1016/j.scitotenv.2026.181708

Adomat, Y., Grischek, T. (2021) Sampling and processing methods of microplastics in river sediments - A review. *Science of The Total Environment* 758, 143691. doi:10.1016/j.scitotenv.2020.143691

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Kurzweg, L., Hauffe, M., Schirrmeister, S., Adomat, Y., Socher, M., Grischek, T., Fery, A., Harre, K. (2024) Microplastic analysis in sediments of the Elbe River by electrostatic separation and differential scanning calorimetry. *Sci. Tot. Environ.* 930, 172514. doi:10.1016/j.scitotenv.2024.172514

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