

Microplastics

(almost) everywhere but still difficult to sample?

12th FerryBox workshop

1-2 October 2024

Finnish Meteorological Institute, Helsinki



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What is microplastic?

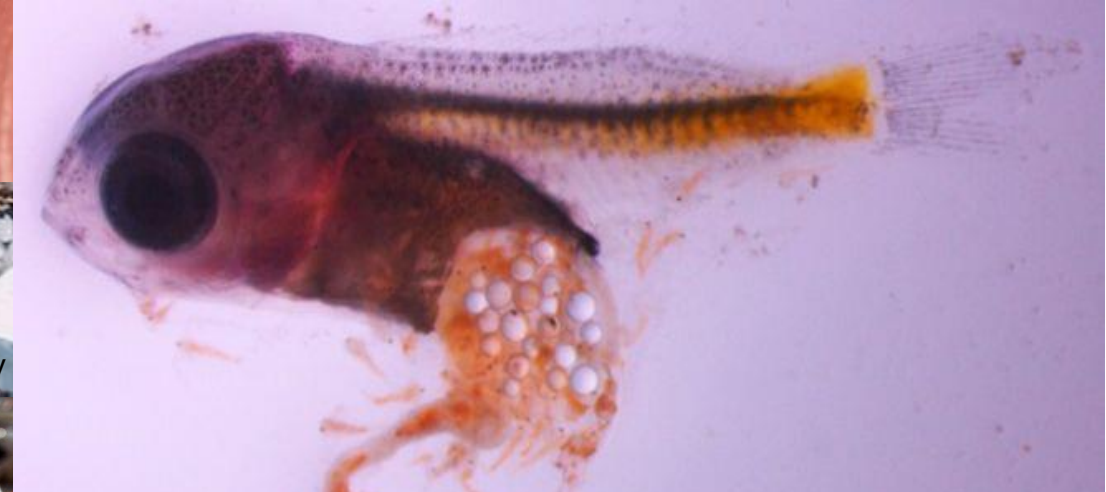
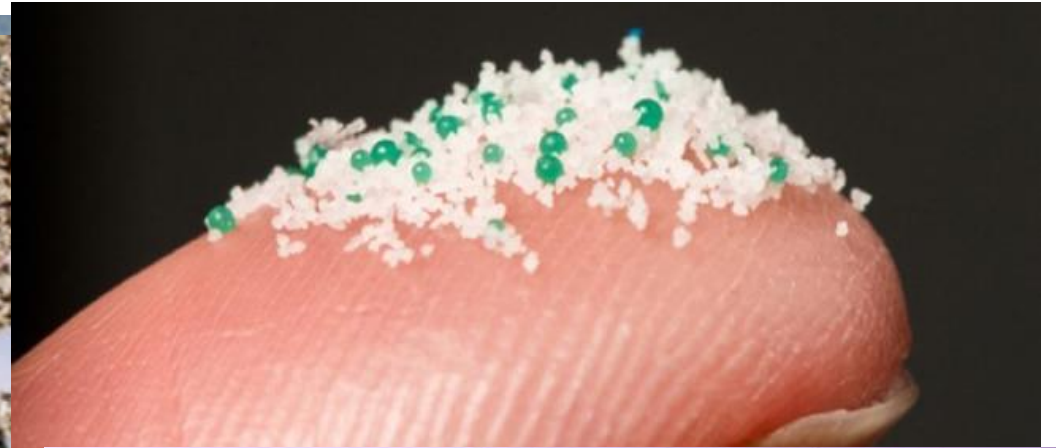


Source: © iStock

What is microplastic?



Source: India Today



A fish larva that has ingested tiny plastic particles.

Source: © Oona Lonnstedt

What is microplastic? Common size divisions

Common size divisions	Field descriptor
> 1 m	mega
25 – 1000 mm	macro
5 – 25 mm	meso
< 5 mm	micro
< 1 μm	nano

Source: GESAMP (2019) Guidelines for the monitoring and assessment of plastic litter and microplastics in the ocean (eds Kershaw P.J., Turra A. and Galgani F.), London, UK, GESAMP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, 130pp. (GESAMP Reports and Studies, No. 99). DOI: <http://dx.doi.org/10.25607/OBP-435>

Manual and semi-automatic devices

by Gunnar Gerds and team

JPI-O FACTS cruise in June/July 2021

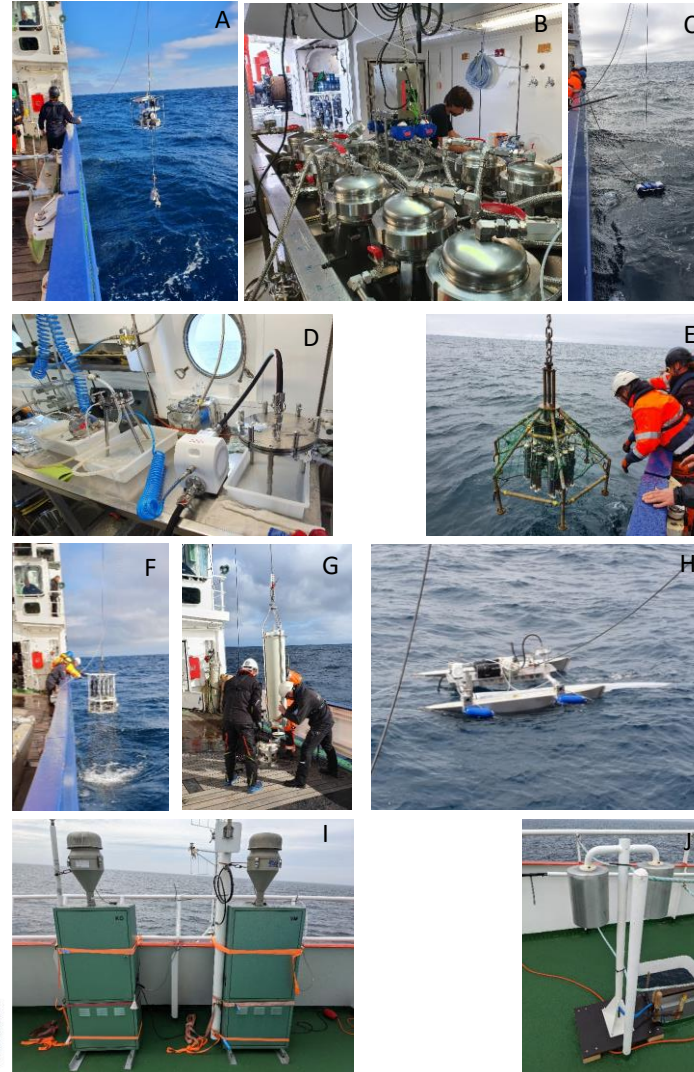
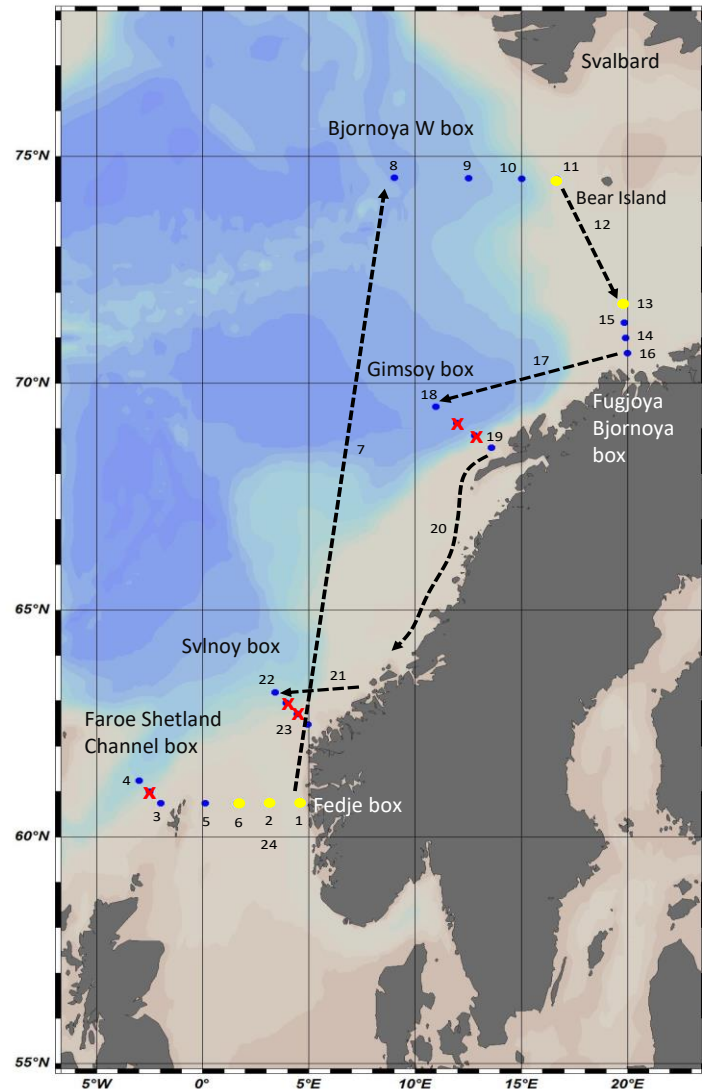
(Fluxes and Fate of Microplastics in Northern European Waters)

<https://jpi-oceans-facts.eu/>

Manual and semi-automatic sampling:

1. **Manual:** outside the ship on a Catamaran or buoy
2. **Semi-automatic:** inside the ship using COMPASS
(Continuous Microplastic Automatic Sampling System)

Field work -- lessons from JPI-O FACTS (June/July 2021)

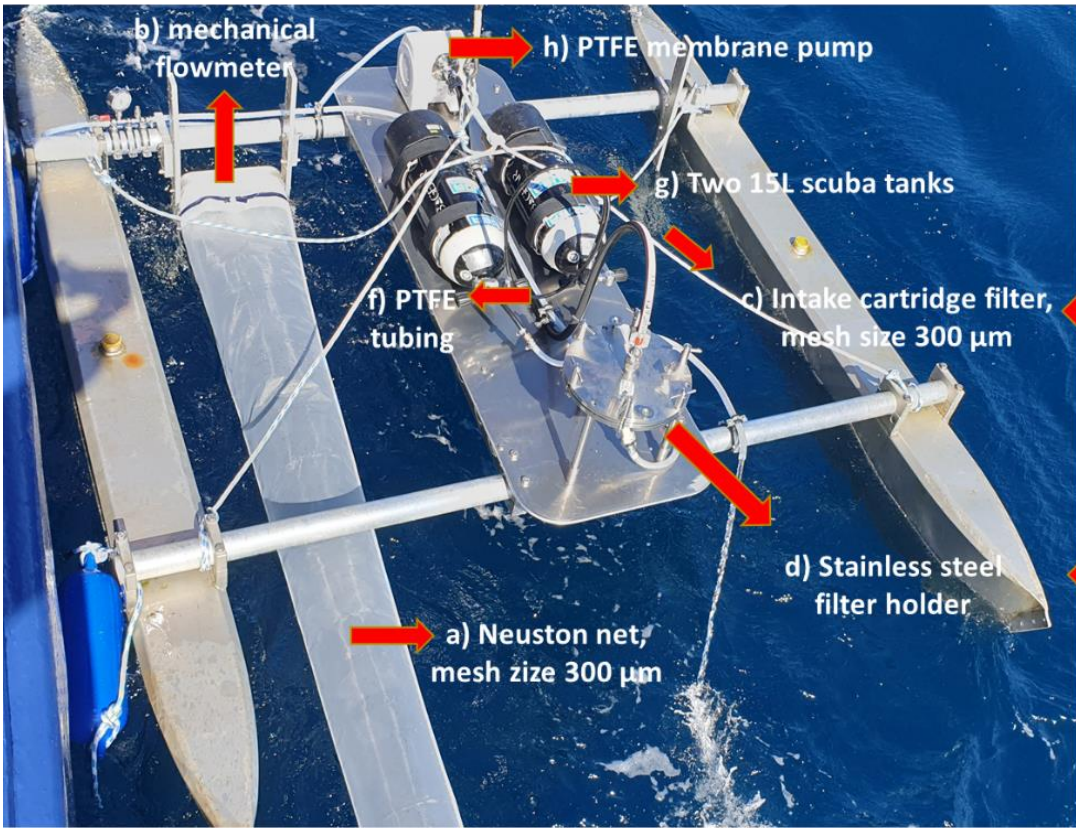


Comprehensive sampling campaign

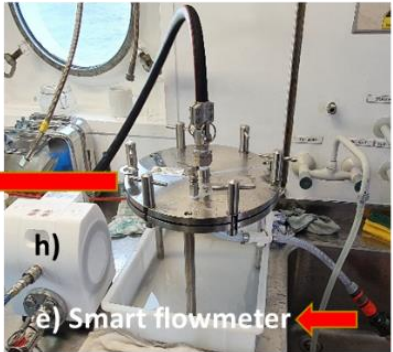
- **Manual: Catamaran or buoy**
at all stations;
up to 40 m³ filtered at 300 μm,
up to 650 L filtered at 10 μm
- **Semi-automated: COMPASS**
at all stations and during „steaming“,
300 μm & 10 μm (combined), > 500 L

Field work -- lessons from JPI-O FACTS (a closer look)

Catamaran & buoy 

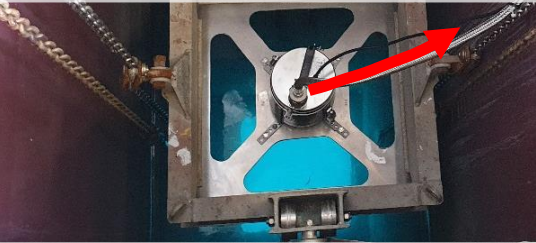


Buoy Sampling



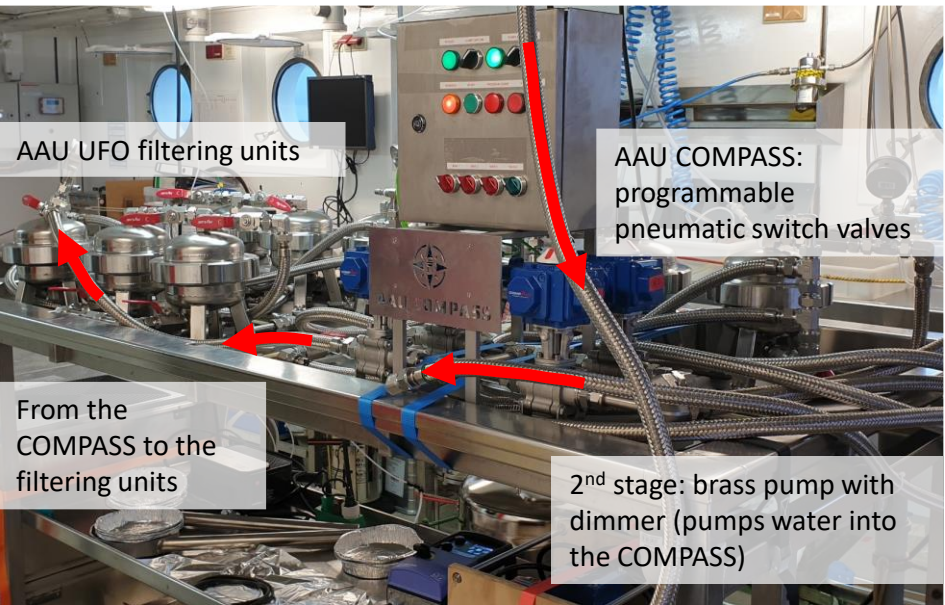
Pumping and filtration system, mesh size 15 μm

1st stage: submersible pump: the water is transported by a metal hose from the moonpool (1st stage) directly to the wet lab (2nd stage)



AALBORG UNIVERSITET

COMPASS



Field work -- lessons from JPI-O FACTS

CATAMARAN → Only „snapshot sampling“ (time/space) ← **COMPASS**

Advantages

- Basic unit (with nets) commercially available
- Adapted unit allows sampling by net and pump/filter-system in parallel
- all subunits of filter/pump-system out of PTFE or stainless steel (contamination reduction)
- 300 µm basket filter (intake) prevents clogging of 10 µm filter

Disadvantages

- **Discrete sampling (on sampling station)**
- Relatively large device
- „tricky“ operation during heavy weather
- **Operation only on research vessels**

Advantages

- **Permanent sampling**
- all subunits of filter/pump-system out of PTFE or stainless steel (contamination reduction)
- Modular (more sub-units possible)

Disadvantages

- Relatively large device
- Complicated and time consuming assembly/installation
- Manual change of filter meshes (possible contamination)
- **Operation only on research vessels**

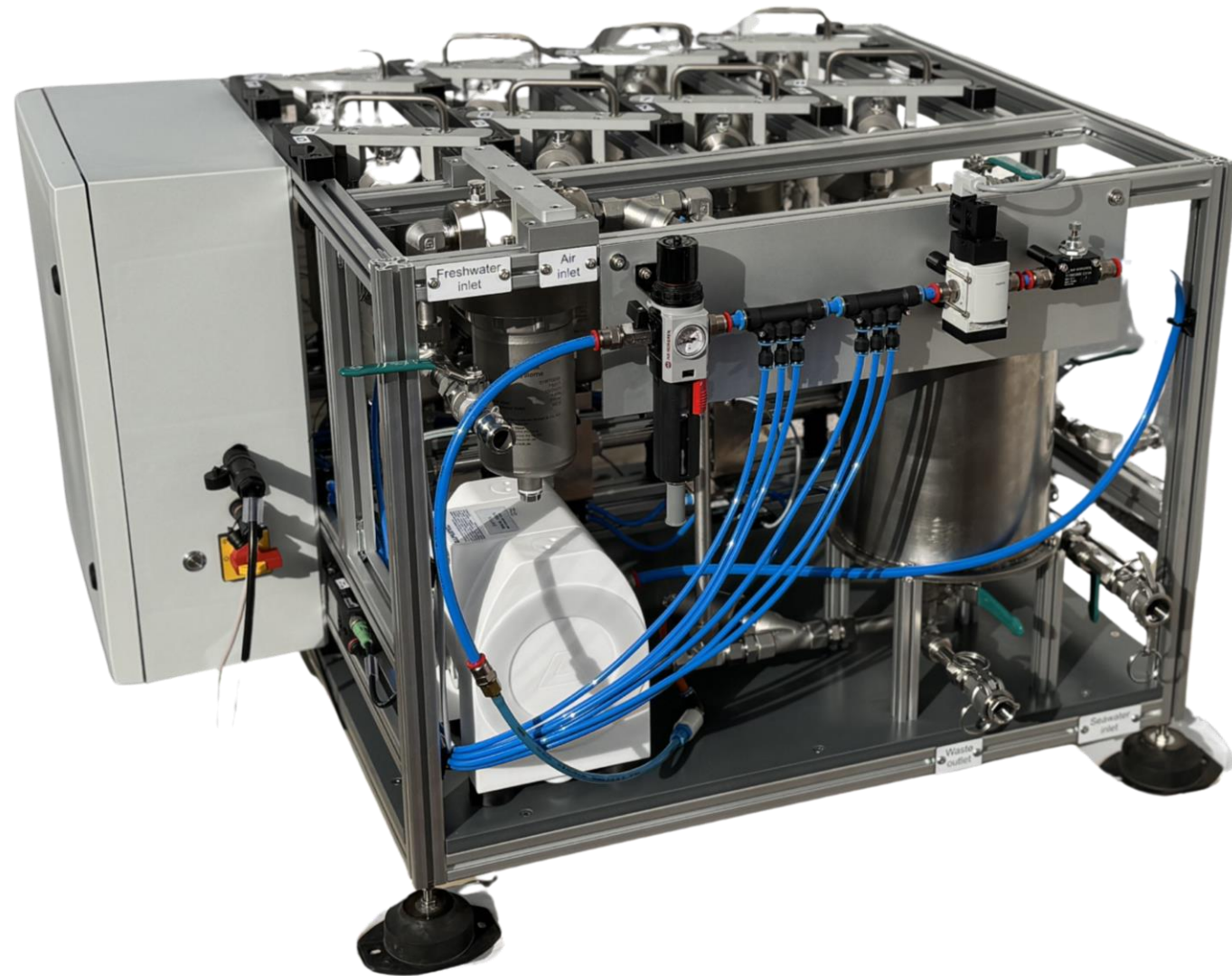
Needed

- MP sampling system for **operation on „ships of opportunity“** (avoiding snapshots)
- **Simple assembly/installation** (opportunistic usage of seawater intake (deckwash), compressed air and electricity)
- **Small footprint**
- **Automated operation** (programmable time, position, volume etc.)
- **Low maintenance** (avoid clogging and cross contamination)
- **Contamination reduction** (safe replacement of complete filter units [cartridge filters])

Transferring the experience into an
automated and autonomous system

New automatic microplastic sampler

- Made from stainless steel and PTFE
- Easy to maintain or to change filter units
- Sample pre-filtration: 300 μm
- 8 separate cartridge filters: 10 μm (others possible)
- Rinsing by pre-filtered (5 μm) tap water
- Pressure sensor & flow meter
- Automated control (on board software)



New automatic microplastic sampler

General mode of operation

- Water is pumped into the system via installed PTFE pump
- Pre-filtering
 - of samples (self cleaning; avoid clogging)
 - of tap water (rinsing of the system)
- Individual filters are activated by valves (selectable via software)
- Duration, quantity or position of sampling can be configured
- Pressure monitoring (prevent clogging)
- Monitoring of the position and pumped volume
(samples can be assigned spatially/temporally; concentration calculations from water volume and filtered MP quantity)

New automatic microplastic sampler - Why prefilter?

Why prefilter?

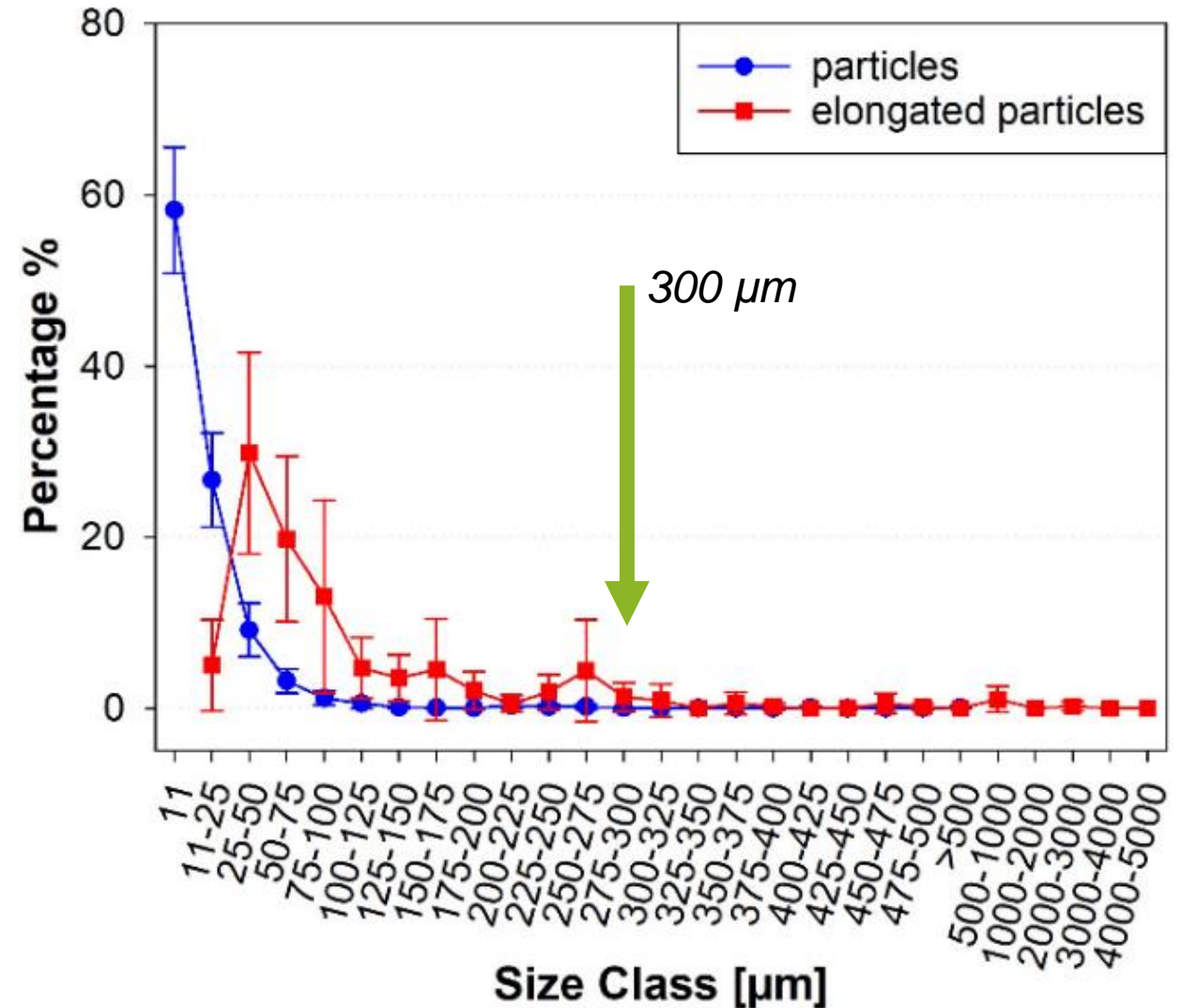
Avoiding clogging of
final filter (by e.g. algae blooms)

Why 300 μm ?

Usual cut-off for larger MP
(usage of neuston nets)

Loosing particles?

The majority of MP particles
is smaller than 300 μm



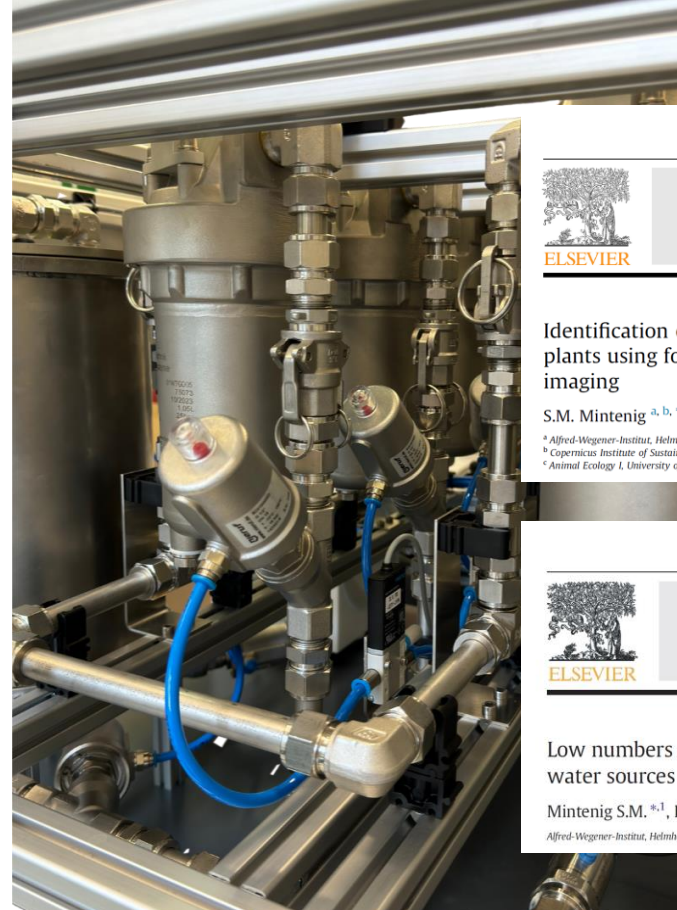
New automatic microplastic sampler - Why cartridge filters?

Why cartridge filters?

- Avoiding contamination
- Sampling (on ship) **AND** extraction (in lab) in one unit
- Approved approach

Why stainless steel cartridge filters?

- Avoiding contamination by housing (Mintenig et al., 2017, Mintenig et al., 2019)



Identification of microplastic in effluents of waste water treatment plants using focal plane array-based micro-Fourier-transform infrared imaging

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^a Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Biologische Anstalt Helgoland, P.O. Box 180, 27483 Helgoland, Germany
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^c Animal Ecology I, University of Bayreuth, Universitätsstraße 30, 95440 Bayreuth, Germany



Low numbers of microplastics detected in drinking water from ground water sources

Mintenig S.M. ^{a, 1}, Löder M.G.J. ^{a, 2}, Primpke S., Gerdts G.

Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Biologische Anstalt Helgoland, P.O. Box 180, 27483 Helgoland, Germany

Software

New automatic microplastic sampler

Software – sampling configuration

4 JENA ENGINEERING Microplastic Sampler

Control Settings **Sampler data**

Sampler mode

UTC date time

UTC date time

Consecutive sequence by time

GPS position

--- SIMULATION ---

		time	End date	End time
1	<input checked="" type="checkbox"/>	01/01/2024	00:06:00	01/01/2024 00:07:00
2	<input checked="" type="checkbox"/>	01/01/2024	00:07:00	01/01/2024 00:08:00
3	<input checked="" type="checkbox"/>	01/01/2024	00:08:00	01/01/2024 00:09:00
4	<input checked="" type="checkbox"/>	01/01/2024	00:09:00	01/01/2024 00:10:00
5	<input checked="" type="checkbox"/>	01/01/2024	00:10:00	01/01/2024 00:11:00
6	<input checked="" type="checkbox"/>	01/01/2024	00:11:00	01/01/2024 00:12:00
7	<input checked="" type="checkbox"/>	01/01/2024	00:12:00	01/01/2024 00:13:00
8	<input checked="" type="checkbox"/>	01/01/2024	00:13:00	01/01/2024 00:14:00

Flushing

Flushing filter time

60 sec

Flushing system time

60 sec

Error monitoring

Pressure

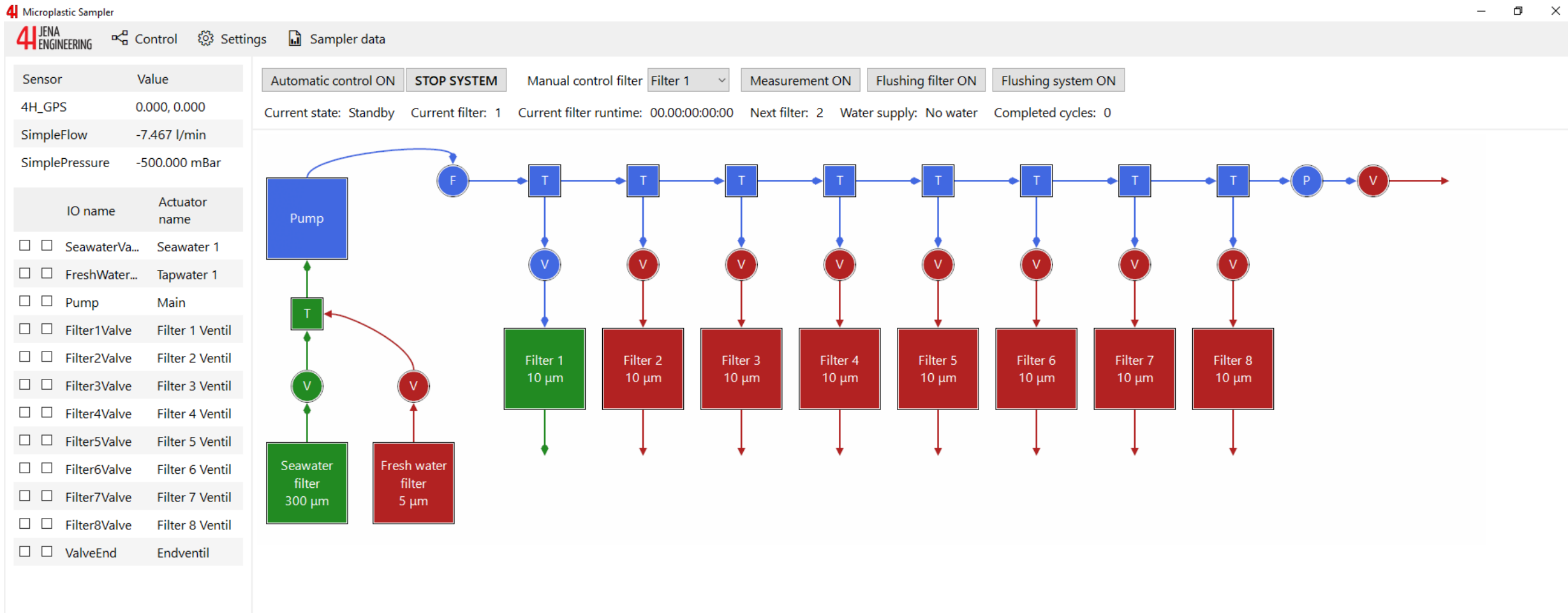
Upper limit value Trigger time

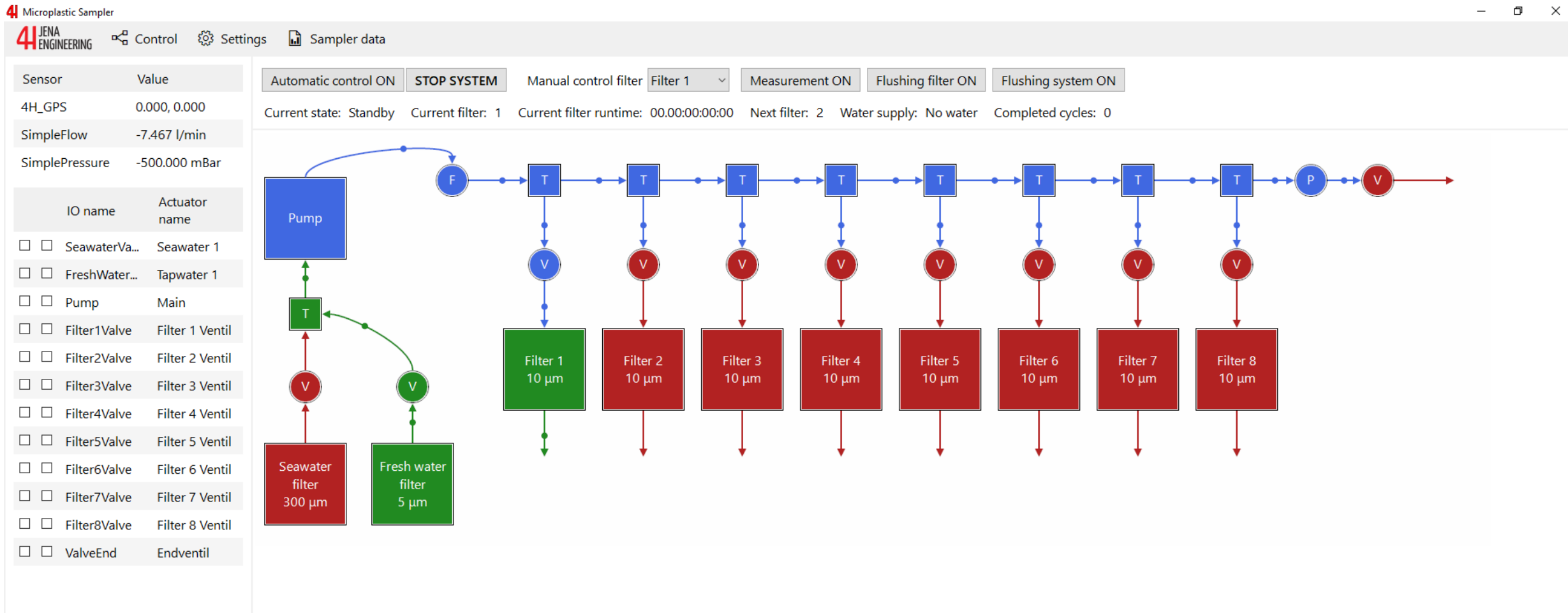
1000.000 mBar 3 sec

Flow rate

Lower limit value Trigger time

5.000 l/min 3 sec





New automatic microplastic sampler

Software – results overview

4 JENA ENGINEERING Microplastic Sampler

Control Settings Sampler data

Export as... Browse... Auto save folder: E:\Programmierung\Programme\Version_8\Revision_0\Build_1\LogData\DeviceLog

☒ View measurement data ☒ View flushing data

	GPS start position (measurement)	GPS end position (measurement)	UTC start date time (measurement)	UTC end date time (measurement)	Total time (measurement)	Total volume (measurement)	UTC start date time (flushing)	UTC end date time (flushing)	Total time (flushing)	Total volume (flushing)
1	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
2	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
3	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
4	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
5	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
6	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
7	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l
8	Unknown	Unknown			00:00:00	0.000l			00:00:00	0.000l

Advantages of this novel sampler:

- Completely free from plastic materials
- Possibility to pre-configure sampling schedule or sample volume
- Internal pressure monitoring prevents from clogging
- Flow meter for sample volume measurement enables for microplastic concentration calculations
- Can be operated autonomously, e.g. on ships-of-opportunity
- Easy to operate and use

Performance tests @AWI – Helgoland in late 2024 (e.g. general operation, recovery etc. etc.)

Installation on the next “Polarstern” (German research vessel) cruise in 2025

Thank you!

Co-development in the framework of NAMC (North Atlantic Microplastics Center; NORCE, Norway)



North Atlantic
Microplastic Centre

