

Brightsite

Transforming industry



Circle

infra partners

Microplastics: Towards quantification in industrial waste-water effluent

Danel Bartlett, Sitech

Lianne van Oord, Circle infra partners

Proud partners

Sitech Services

TNO

Maastricht University

Brightlands Chemelot campus





- **Introduction**
- **Methods for measurement**
- **Results**
- **Conclusion**



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Transforming industry

Chemelot and plastics



- 60 production plants on site
- 2.3 billion kg of plastic is produced on Chemelot each year
- Broad range of plastics produced and recycled on the Chemelot site

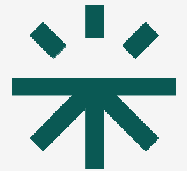


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- Plants have their own wastewater treatments or preventative measures in place.
- 200 km of sewers.
- Clarifiers.
- Biological wastewater treatment plant responsible for the whole site:
 - Integrale Afvalwater Zuivering Installatie (IAZI).
- Wastewater from IAZI is returned to the river Meuse.
- Permit allows 14 000 kg “plastics” in effluent. Plastic definition deviates from generally used ‘solid plastic particles < 5mm’.
- This research was conducted to get measured information.





No standard for sampling microplastics

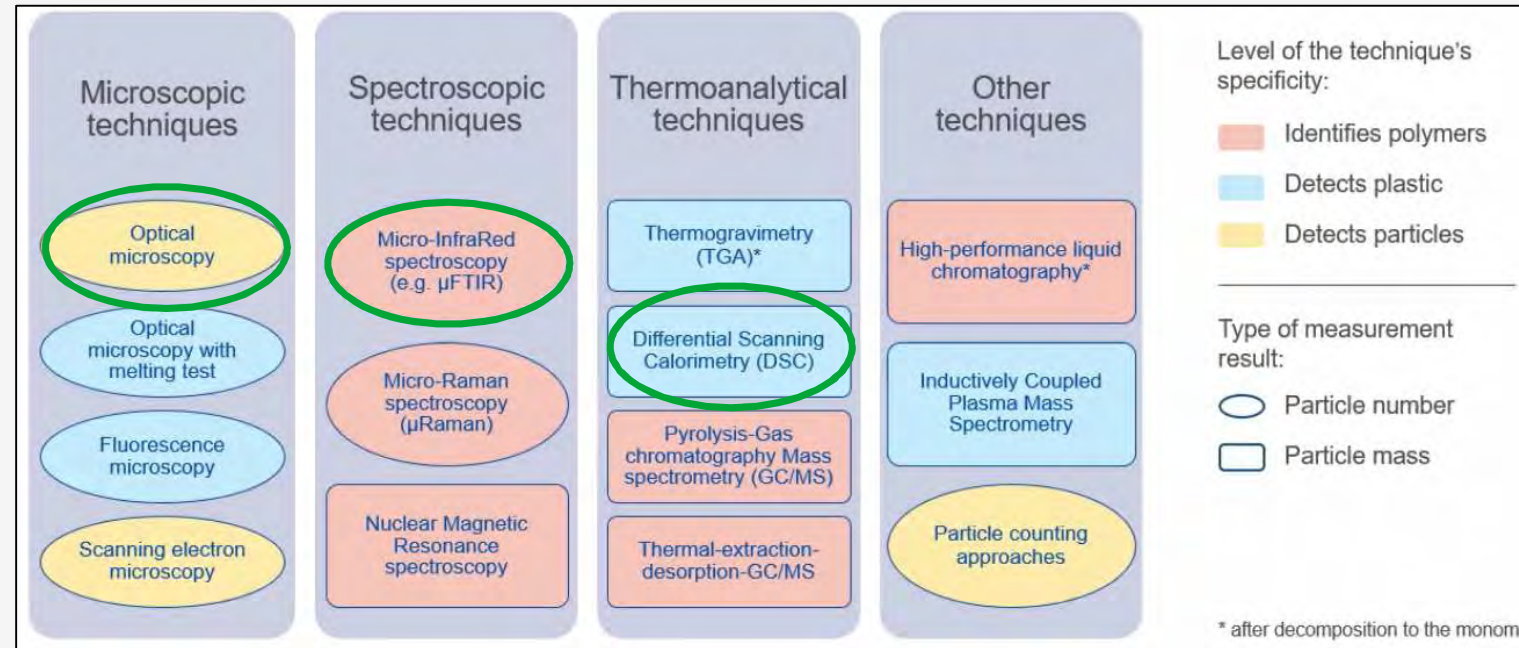
- Possible sampling approaches:
 1. Selective sampling
 2. Bulk sampling
 3. Volume reduced sampling
- Sampling techniques:
 - Rijkswaterstaat (RWS):
 - Cascade sieves and sediment box
 - KWR:
 - Cascade sieves & membrane filtration



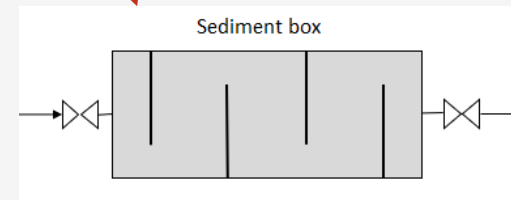
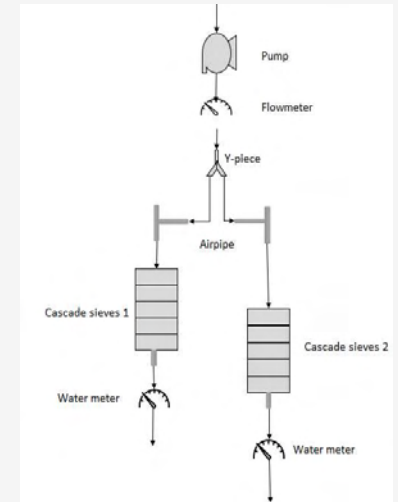
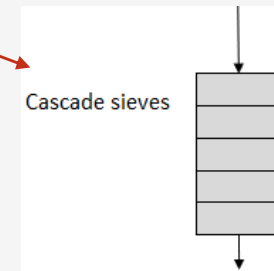
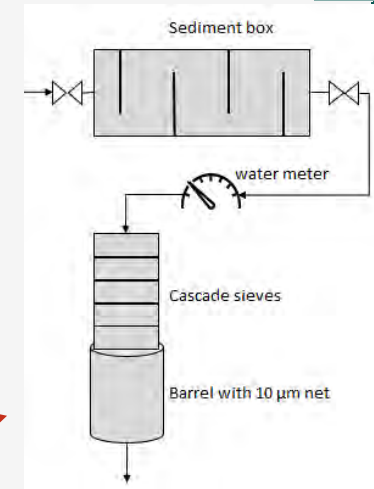
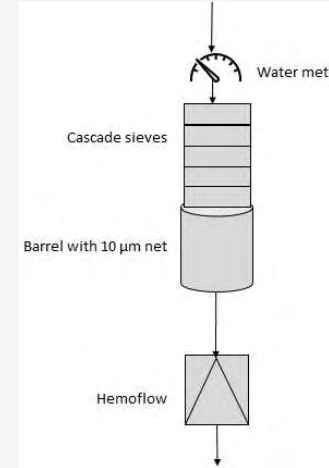
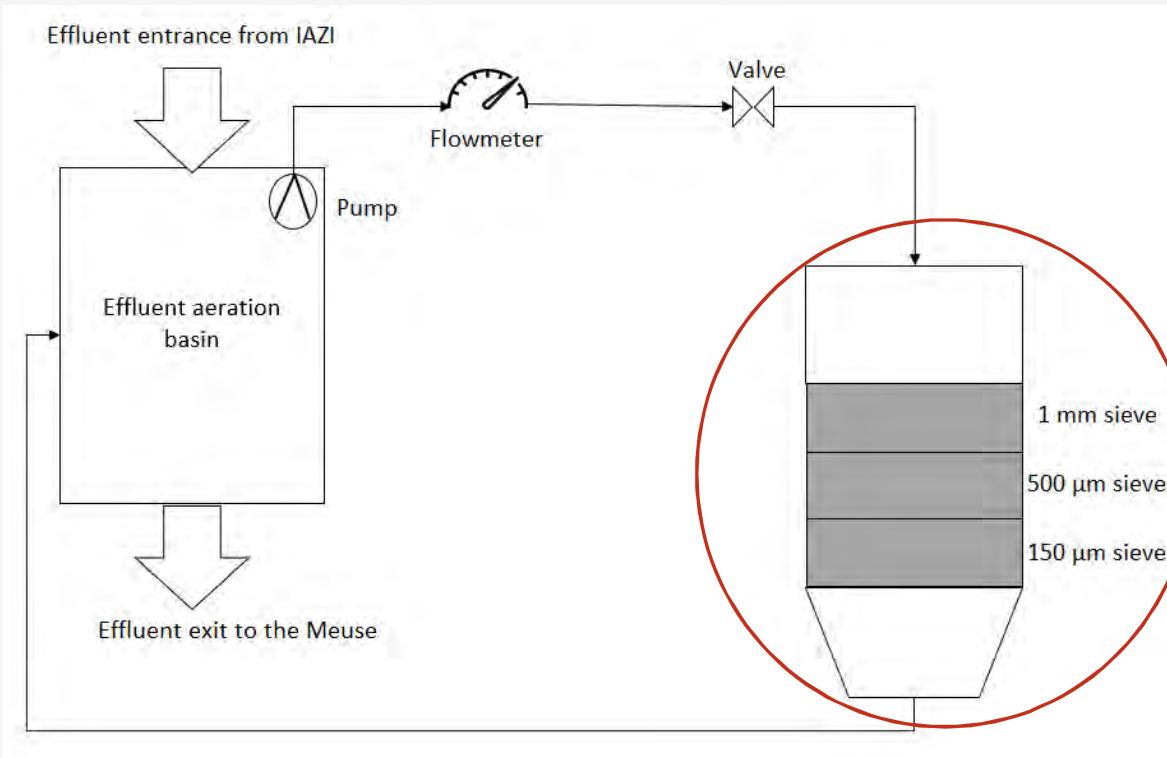


No standard for analysing microplastics

- Sample preparation:
 - Dried and weighed
 - Cryogenic milling
 - Biomass removal



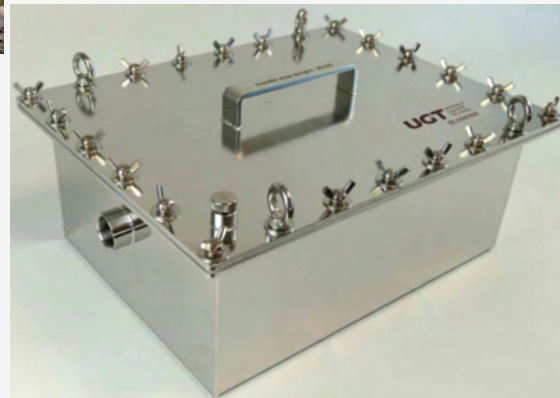
Measuring microplastics in the effluent



Measuring microplastics in the effluent - equipment



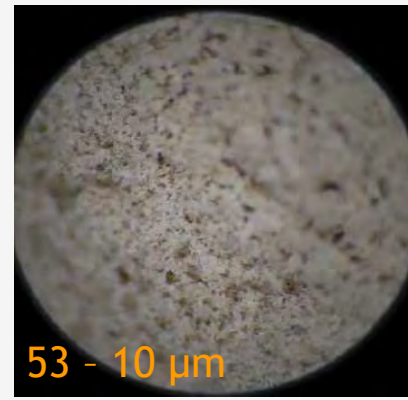
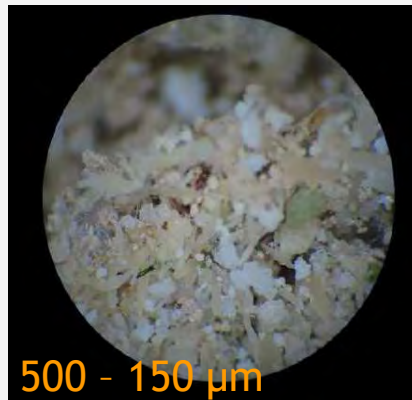
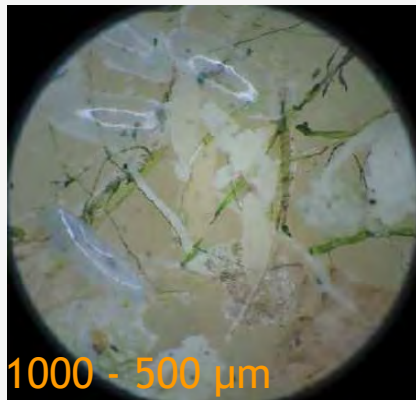
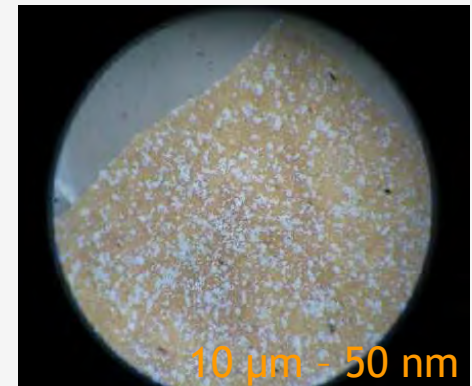
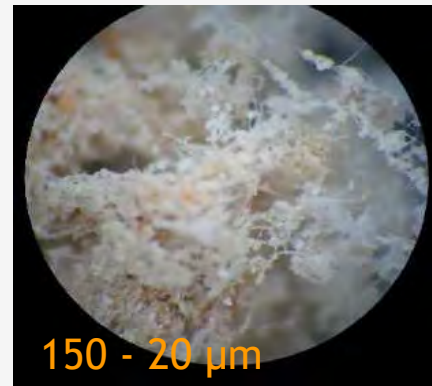
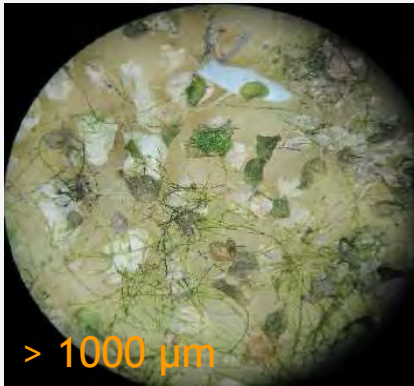
Aanpak	Monstername methode	Periode	Locatie
Opzet 1	Grote zeven	Juni 2020 - Okt 2023	IAZI
Opzet 2a	KWR-zeven + Hemoflow	Juli 2023	IAZI
Opzet 2b	Sedimentkist + KWR-zeven	Juli 2023	IAZI
Opzet 3a	IAZI-zeven	Augustus 2023	IAZI
Opzet 3b	Sedimentkist	Augustus 2023	IAZI
Opzet 4	IAZI-zeven	Oktober 2023	IAZI
Opzet 5	KWR-zeven + Hemoflow	Oktober 2023	KWR



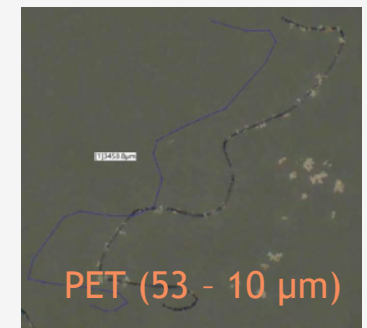
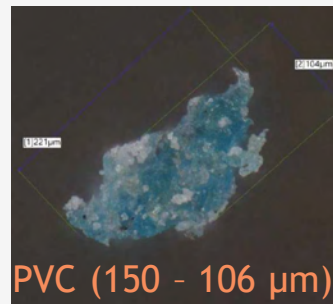
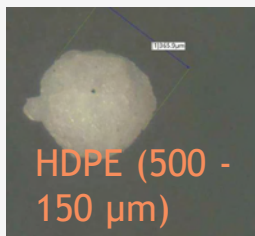
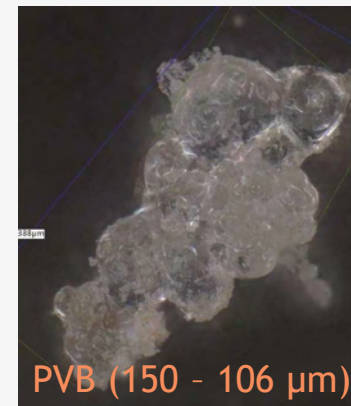
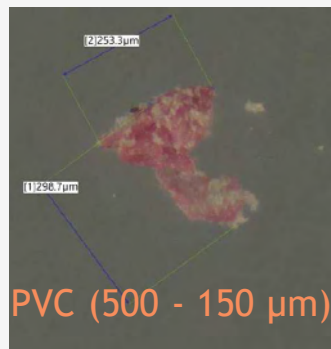
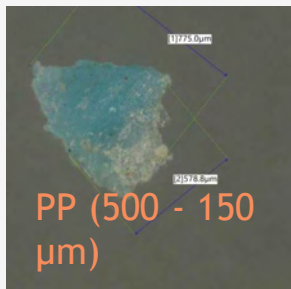
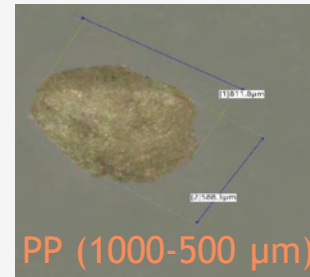
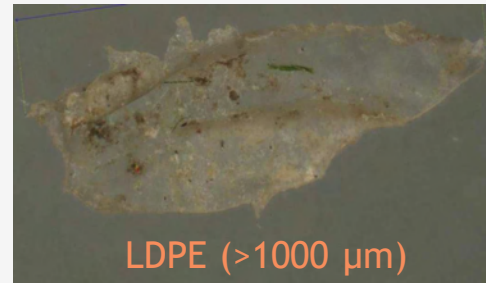
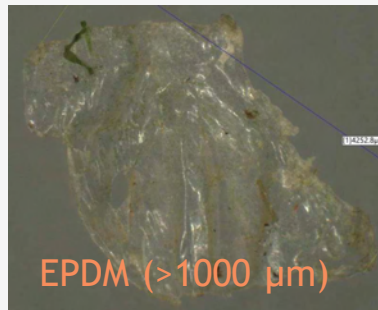
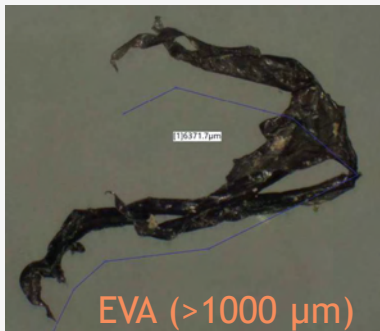
Samples collected from the effluent



Microscopic photos of samples



μ-FTIR particle identification



Calculating yearly discharge of microplastics

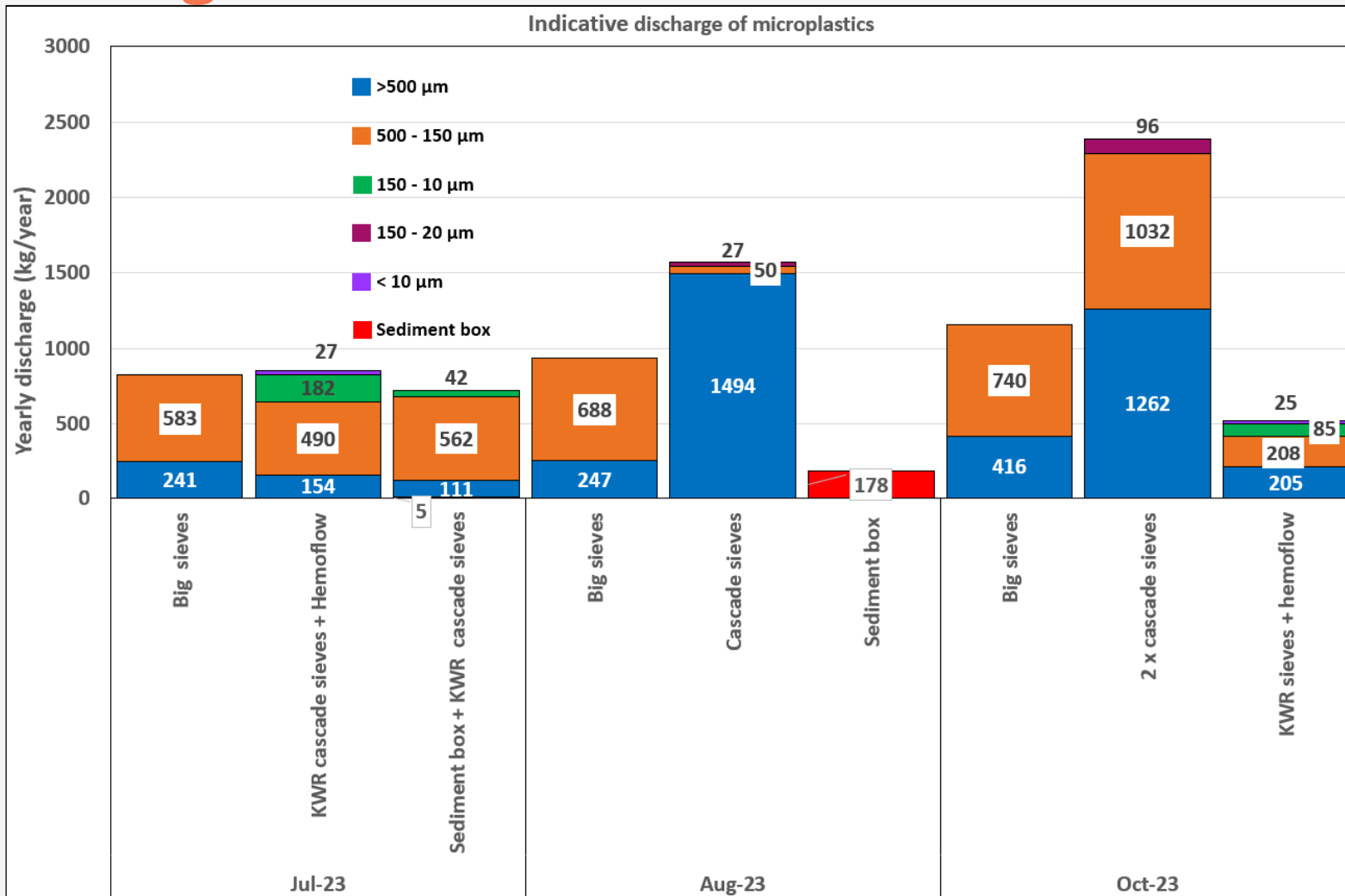


Yearly discharge $\left(\frac{kg}{year}\right) =$

$$\frac{\text{Concentration of microplastics in the sample} \left(\frac{mg}{m^3}\right)}{1000000}$$

\times *Average flowrate of effluent during the sampling period* $\left(\frac{m^3}{hour}\right)$

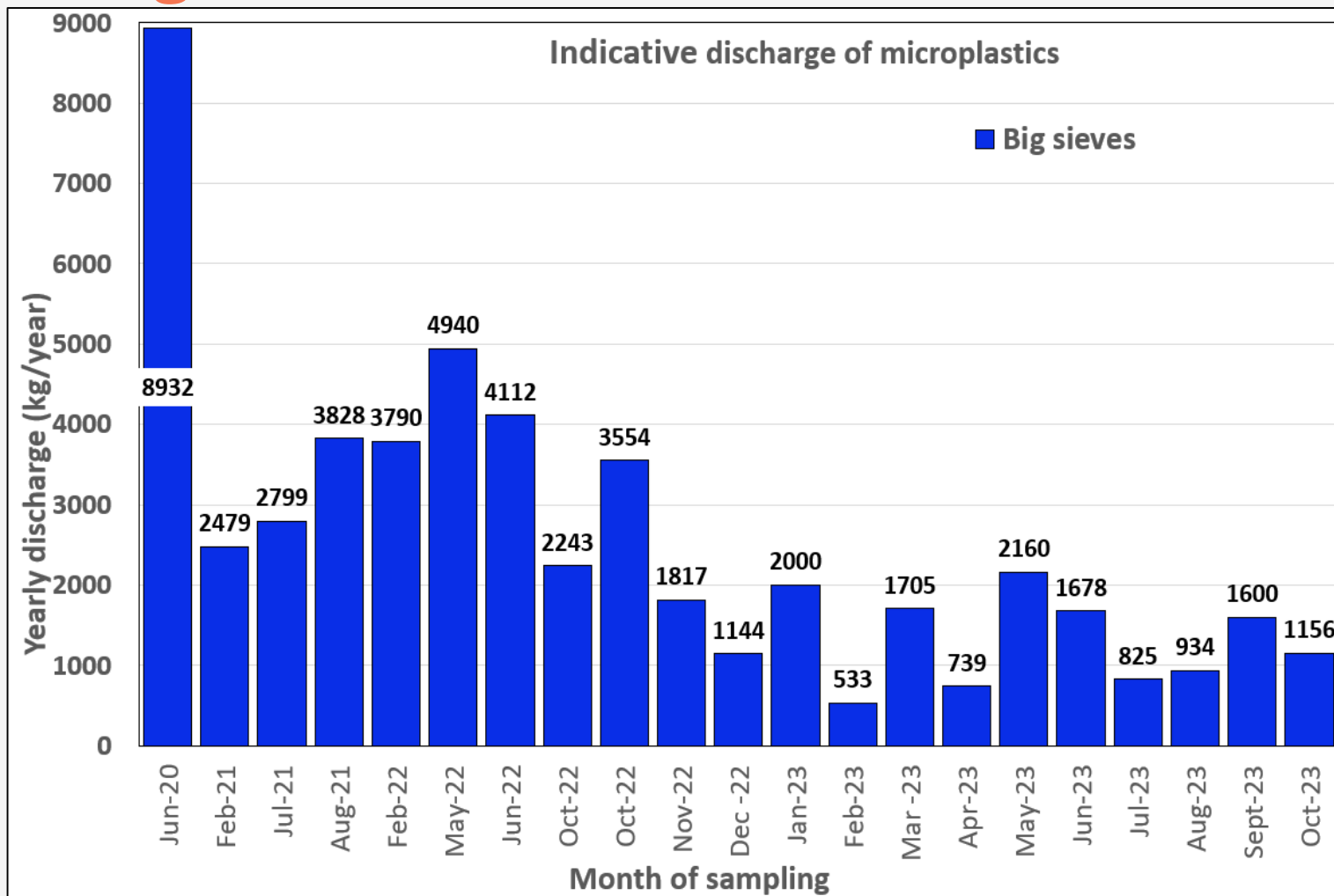
$$\times 8760 \left(\frac{hour}{year}\right)$$



Points of interest:

- > 500 µm & 500 – 150 µm
 - 78 – 98 % of microplastics
- Sediment box is ineffective for the IAZI's effluent

Yearly discharge of microplastics



Points of interest:

- Average yearly discharge (2020-2023): $2,5 \pm 1,9$ ton
- Types of plastic found: HDPE; LDPE; PP; LLDPE; EPDM; PA 4-6; PET; UHMWPE; Natural rubber; PA 6; PA 66; and EVA
- In perspective:
 - 200 tons of microplastic enters the Netherlands through the Meuse river every year
 - Chemelot's contribution to that is less than 2 %



- **Quantified microplastics in the effluent**
 - $2,5 \pm 1,9$ ton
 - >78% of microplastics are larger than 150 μm
- **Identified the microplastics in the effluent**
 - HDPE
 - LDPE
 - PVB
 - UHMWPE
 - PP
 - LLDPE
 - PA 4-6
 - PA 6
 - PET
 - PVC
 - EPDM
 - PA 66
 - EVA
- **No standards are available**
 - The insights gained forms a basis for further development
- **Continue using the sieves as a sampling methodology until a standard is published.**



- **EU regulation 11/3/2024: Methodology for measuring microplastics in water for human consumption.**
 - filter cascade to collect particles and fibres
 - optical microscopy or chemical mapping to determine individual particle size and shape,
 - vibrational micro-spectroscopy to identify particle compositions.
 - methodology limited to particles 20 µm to 5 mm, fibres length 20 µm to 15 mm.
 - microplastics concentration expressed as the number of microplastics per cubic metre of water and classified according to pre-determined size ranges, shape and composition categories
 - minimum volume of 1 000 (thousand) litres of water shall be sampled
- 'the methodology for measuring microplastics should be proportional, appropriate and cost-efficient'

Status for waste water ?



Thank you!