ATV Jord og Grundvand om
Mikroplast i miljøet

Mikroplast i regn- og spildevand – forekomst, analysemetoder, og usikkerheder

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The Issue of Quantification

BASEMAN
Defining the baselines and standards for microplastics analyses in European waters

JPI OCEANS
www.jpi-oceans.eu

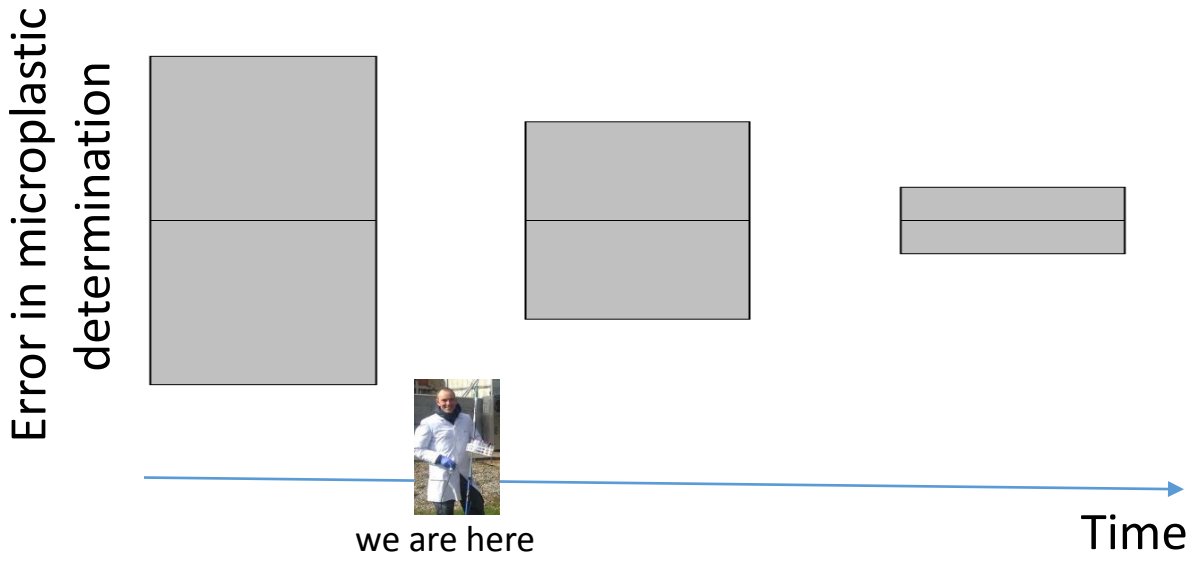
http://www.jpi-oceans.eu/baseman

Citation from BASEMAN:

Although microplastics (MP) are recognized as an emerging contaminant in the environment,

currently neither sampling, extraction, purification nor identification approaches are standardized,

making the increasing numbers of MP studies hardly - if at all - comparable.



The scientific community works at reaching valid methods

But there is still a lot to do before we have a or several generally accepted and consistent method(s) for quantifying microplastics

Some fundamental problems in quantifying plastics

- Plastics is a diverse group of materials with diverse chemical characteristics
- There are of course the main groups that we know from plastic recycling, like

Viton

Natural Rubber

- There are, though, other types like “rubber”

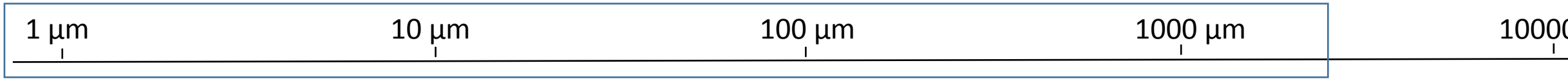
EPDM

- There are composite plastics like fiber-reinforced plastic or milk cartons

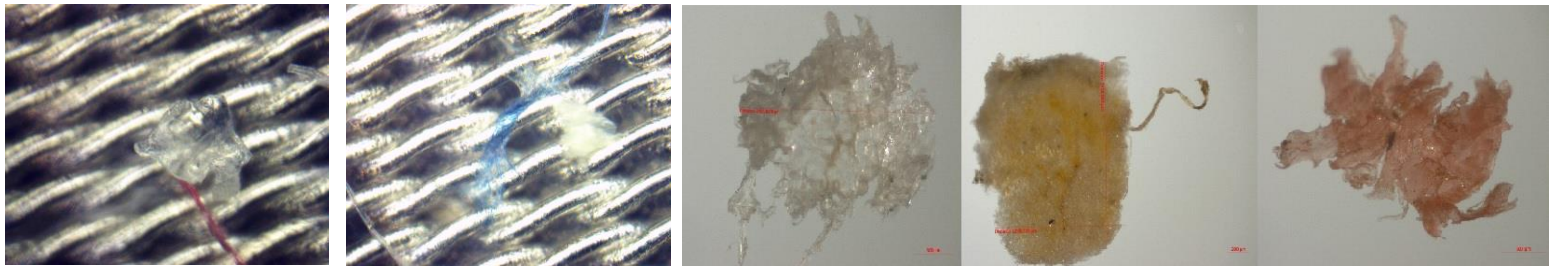
- And so on

Plastic pollution comes in all sizes and shapes

- Sizes



- Shapes



The diversity of plastics is part of what makes it hard to quantify

- Think of plastic quantification as a 3-dimensional issue:

  Size x Shape x Material

- BUT, it gets a even more complicated ☺
- Because: Not all that is out there is plastics
- Before analyzing for plastics we have to isolate them from the matrix they are in





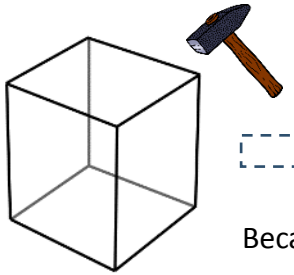

- And fortunately there is much more other stuff out there than plastics

Some fundamental problems in reporting microplastic finds

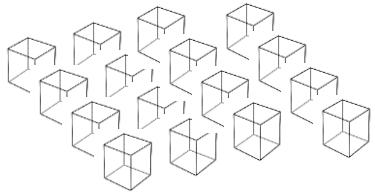
Microplastic finds have been reported as number of particles

- BUT: Particle counts are not a conserved base quantity – particles are brittle

1 particle of
1000 x 1000 x 1000 µm



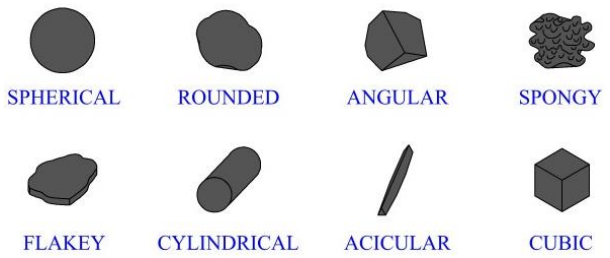
Because $1000^3 = 1{,}000{,}000{,}000$



1,000,000,000 particles of
1 x 1 x 1 µm

Different size ranges are used (e.g. 330-5000 µm versus 10-500 µm)

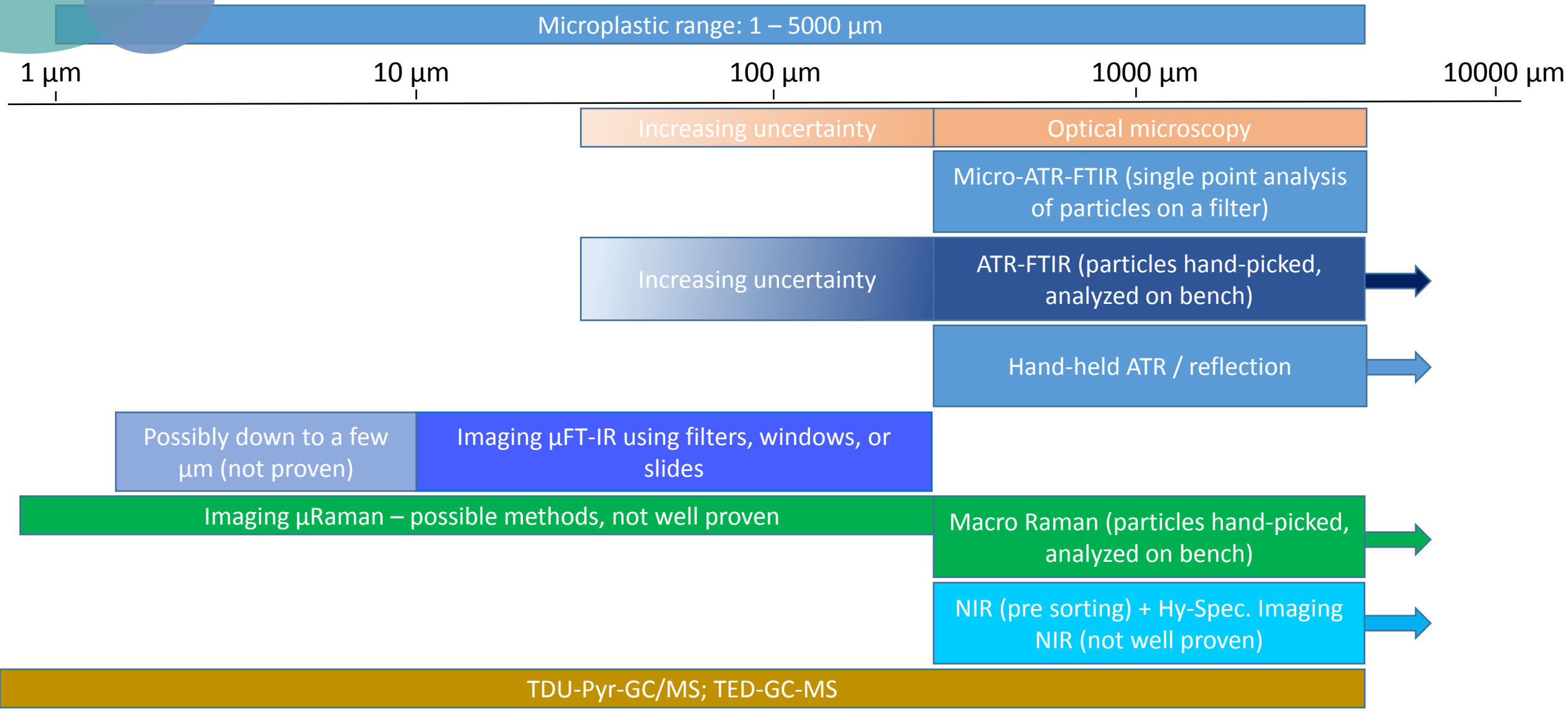
Particle shape is ignored – size is reported by one number only, typically called the "particle size"



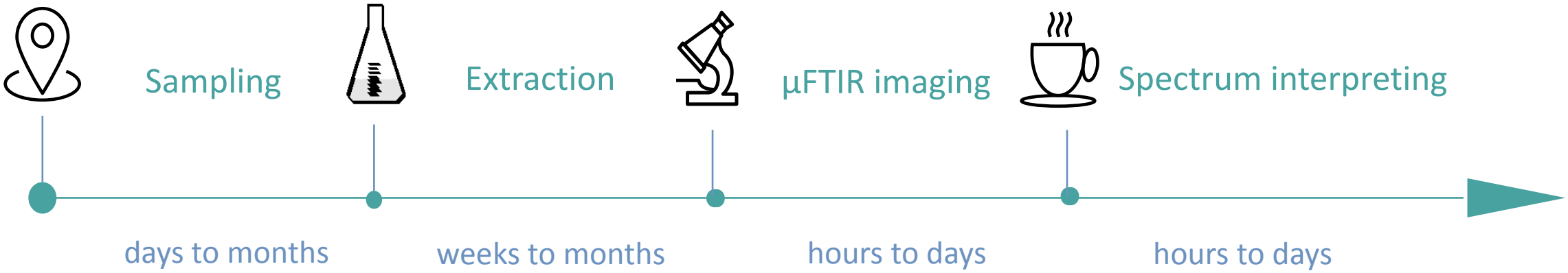
All these particles would be treated as having the same "size"

Particle numbers + sizes are important as impacts increase with decreasing size
BUT
Microplastic mass is needed to establish mass-balances and compare sources

And you do of course have to identify what is plastic

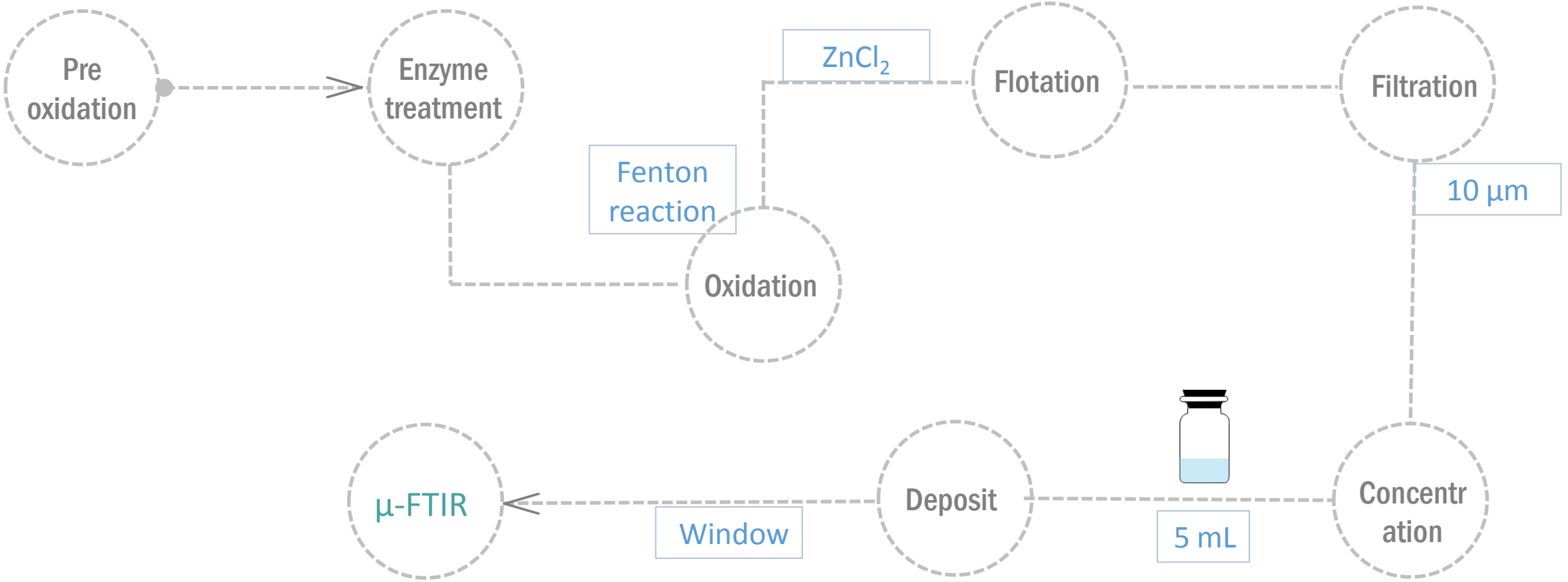


Methodology - overview



PART 3

Methodology - Extraction



Stormwater sampling

7 stormwater ponds
- 3 residential
- 2 industrial
- 1 commercial
- 1 highway

WATER SAMPLE

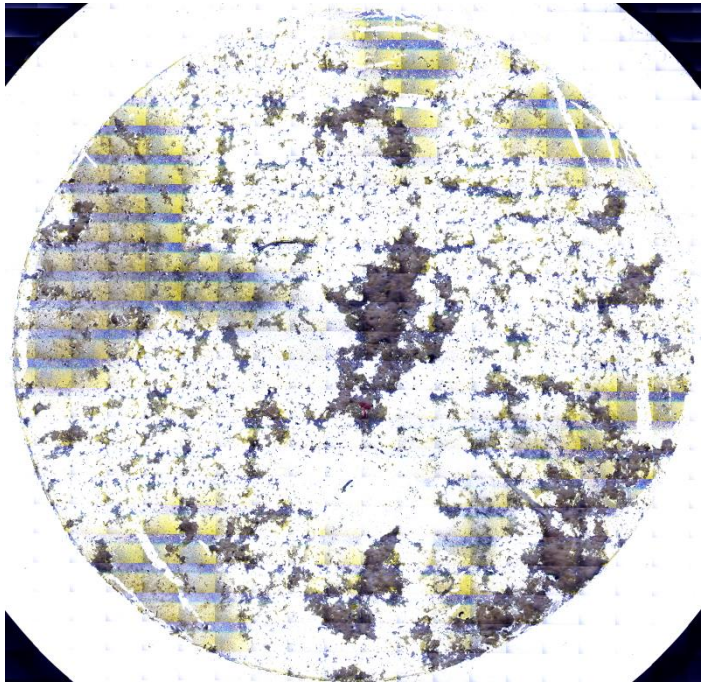
Pumping system with 10 µm filter

- Dry weather
- Three rounds
- 1 m^3

Stormwater methodology - µFTIR & Spectrum interpretation

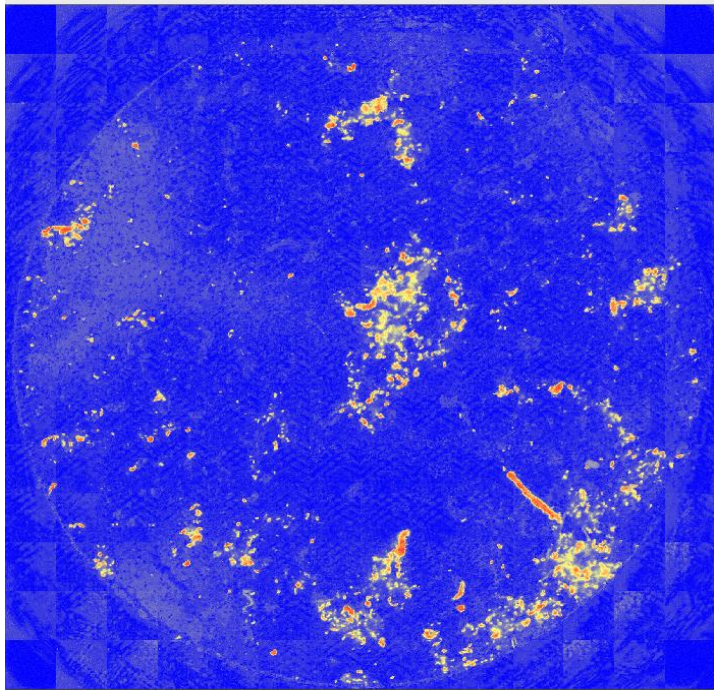
- Scan 3 windows (169-196 tiles each)
- Analyze the whole of all 3 windows

Visual image

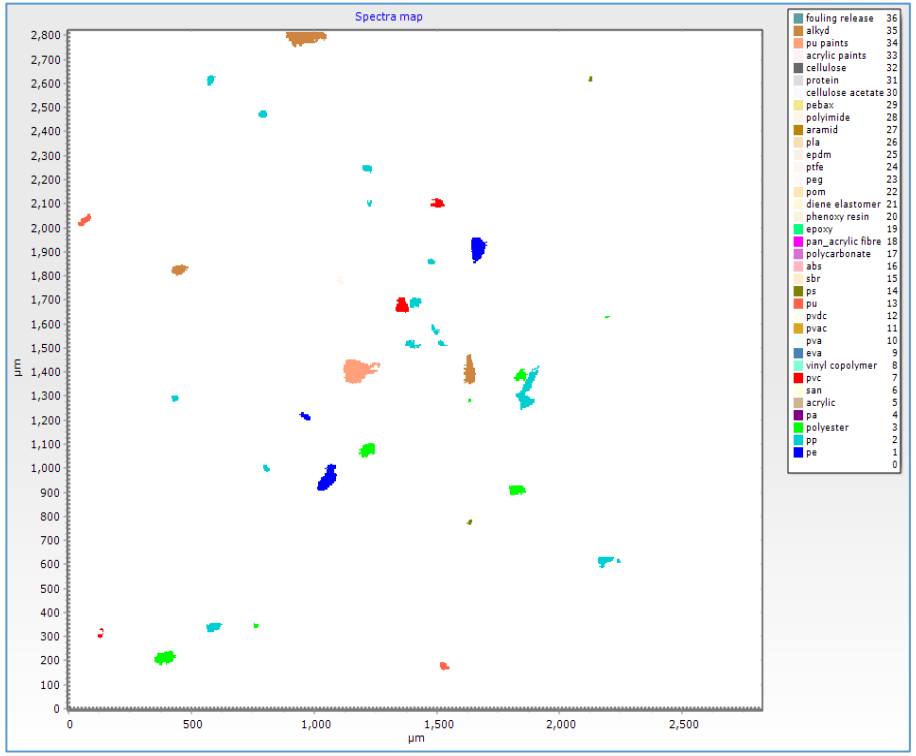


Heat map in MPhunter

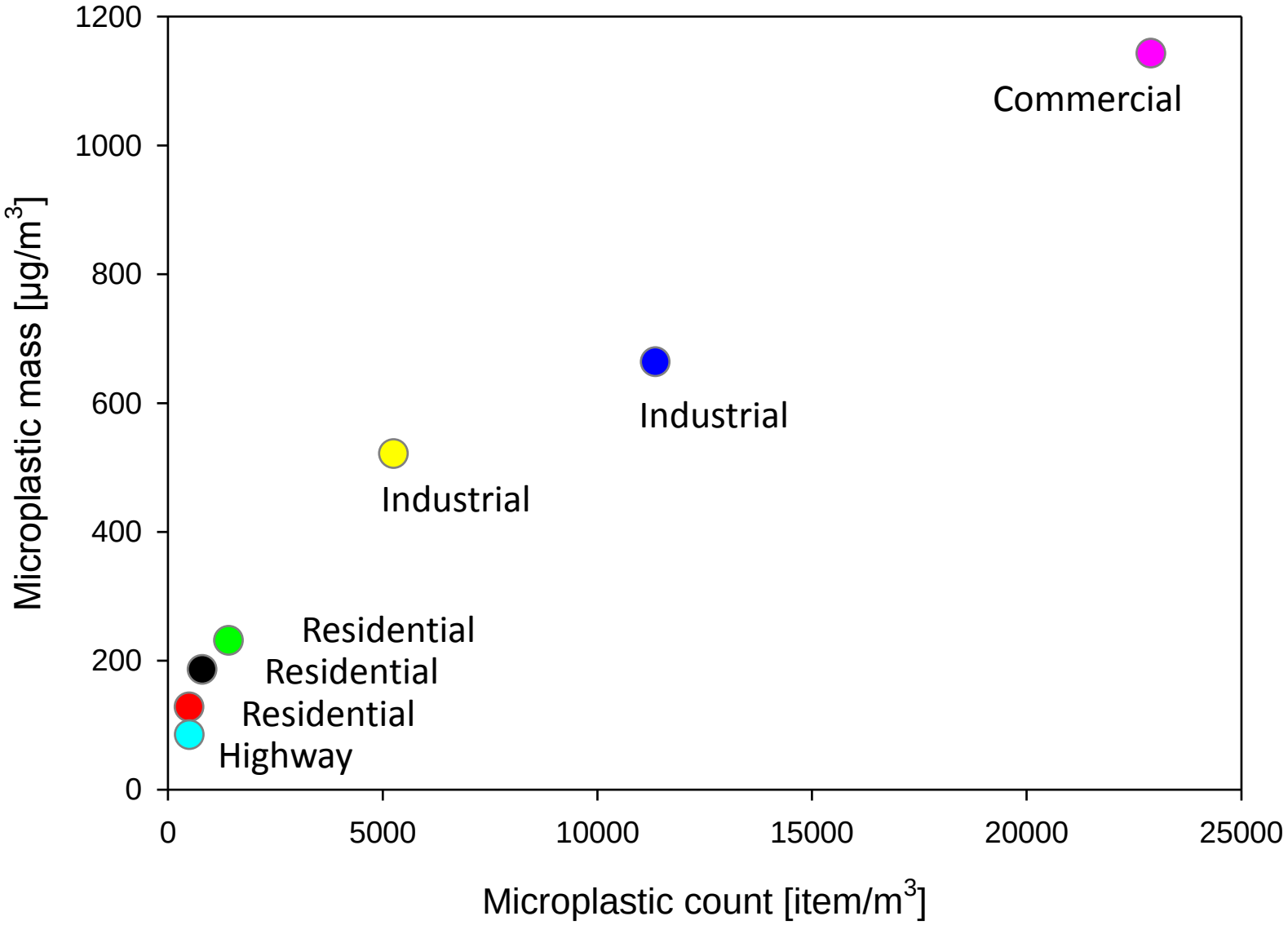
Probability map indicating possible microplastic particles
(PP as reference spectrum)

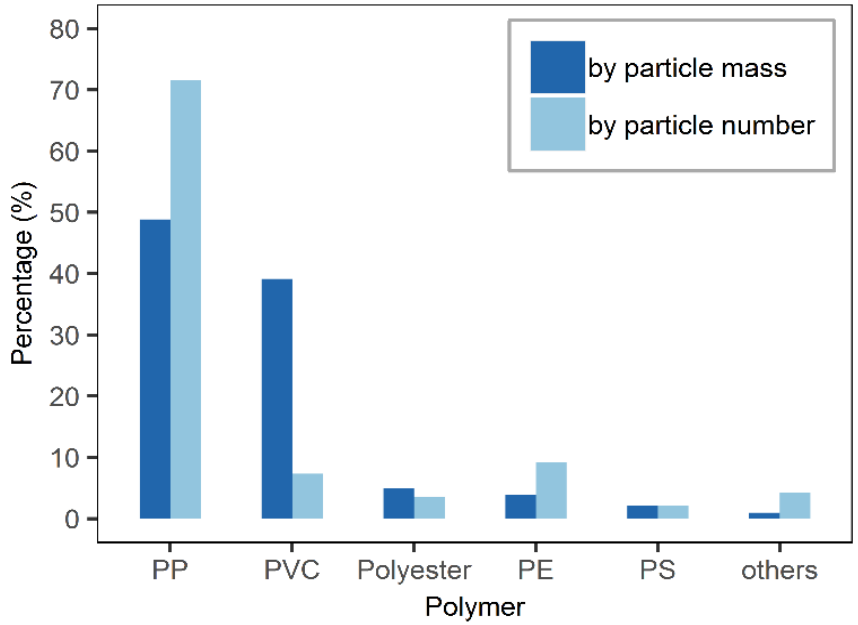


Automated MP recognition in MPhunter



Stormwater results





Wastewater study – 10 of Denmarks largests WWTPs were sampled

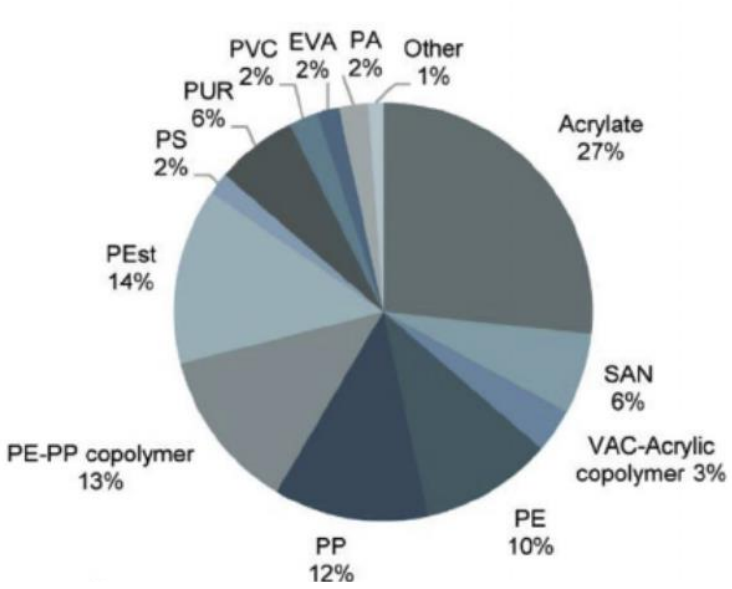
WWTP	Water volume (1000 m^3/y)	Fraction of total Danish wastewater %
Lynetten	55.044	9%
Damhusåen	23.058	4%
Ejby Mølle	19.426	3%
Aalborg Vest	18.608	3%
Marselisborg	9.319	1%
Herning	9.197	1%
Vejle	9.032	1%
Kolding	8.651	1%
Fredericia	8.340	1%
Horsens	7.563	1%
Total	**168.238**	**26%**

Results WWTPs

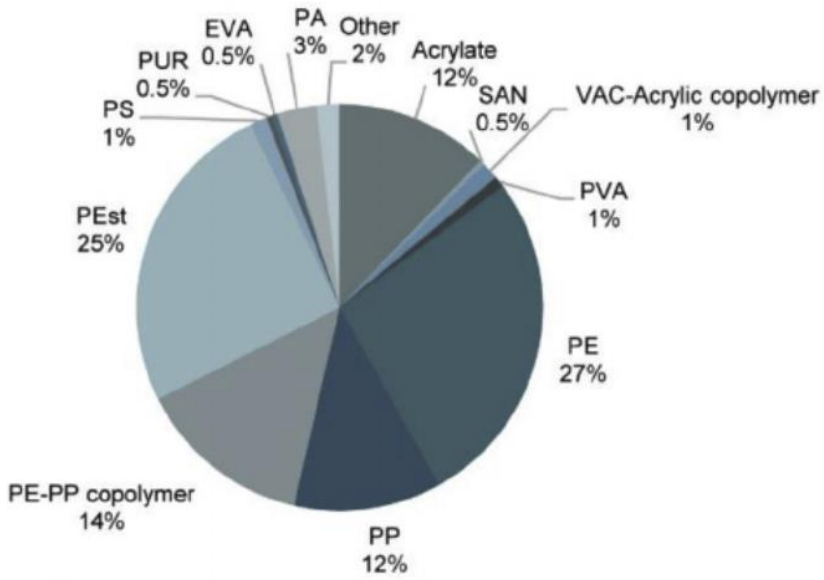
WWTP#		1	2	3	4	5	6	7	8	9	10	Median
Raw wastewater	item/L	10044	8762	6830	6021	18285	4994	2223	8149	7601	5362	7216
	µg/L	181	407	268	193	482	1189	212	407	118	61	250
Treated wastewater	item/L	127	447	42	29	214	182	35	19	43	65	54
	µg/L	3.6	11.9	0.6	0.5	5.4	11.6	0.7	1.4	4.8	3.8	4.2

Polymer composition

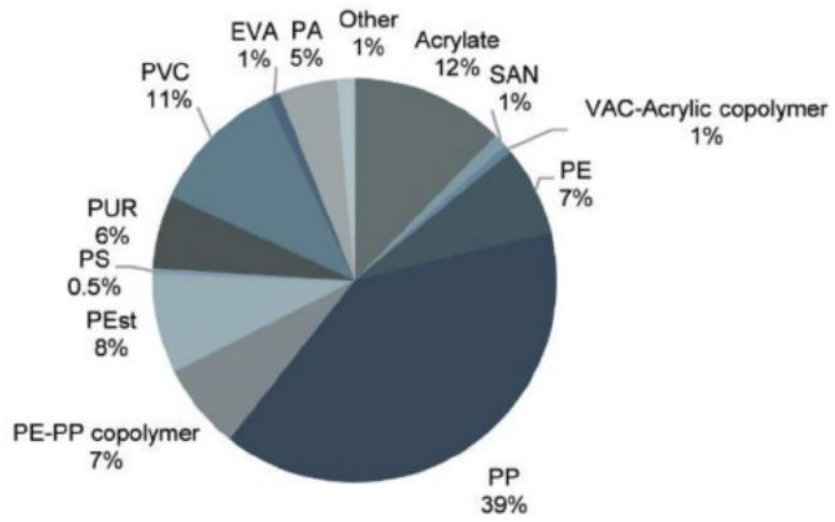
Raw wastewater, MP count



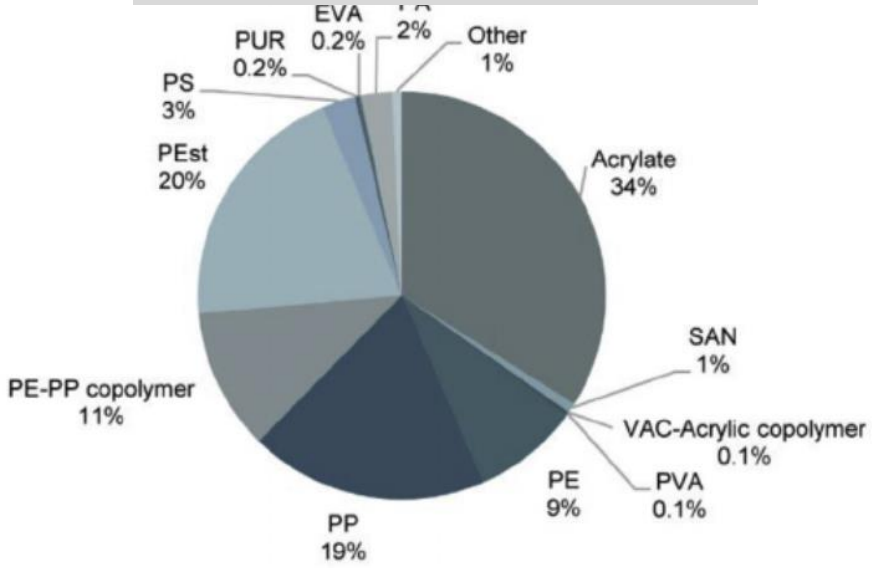
Treated wastewater, MP count



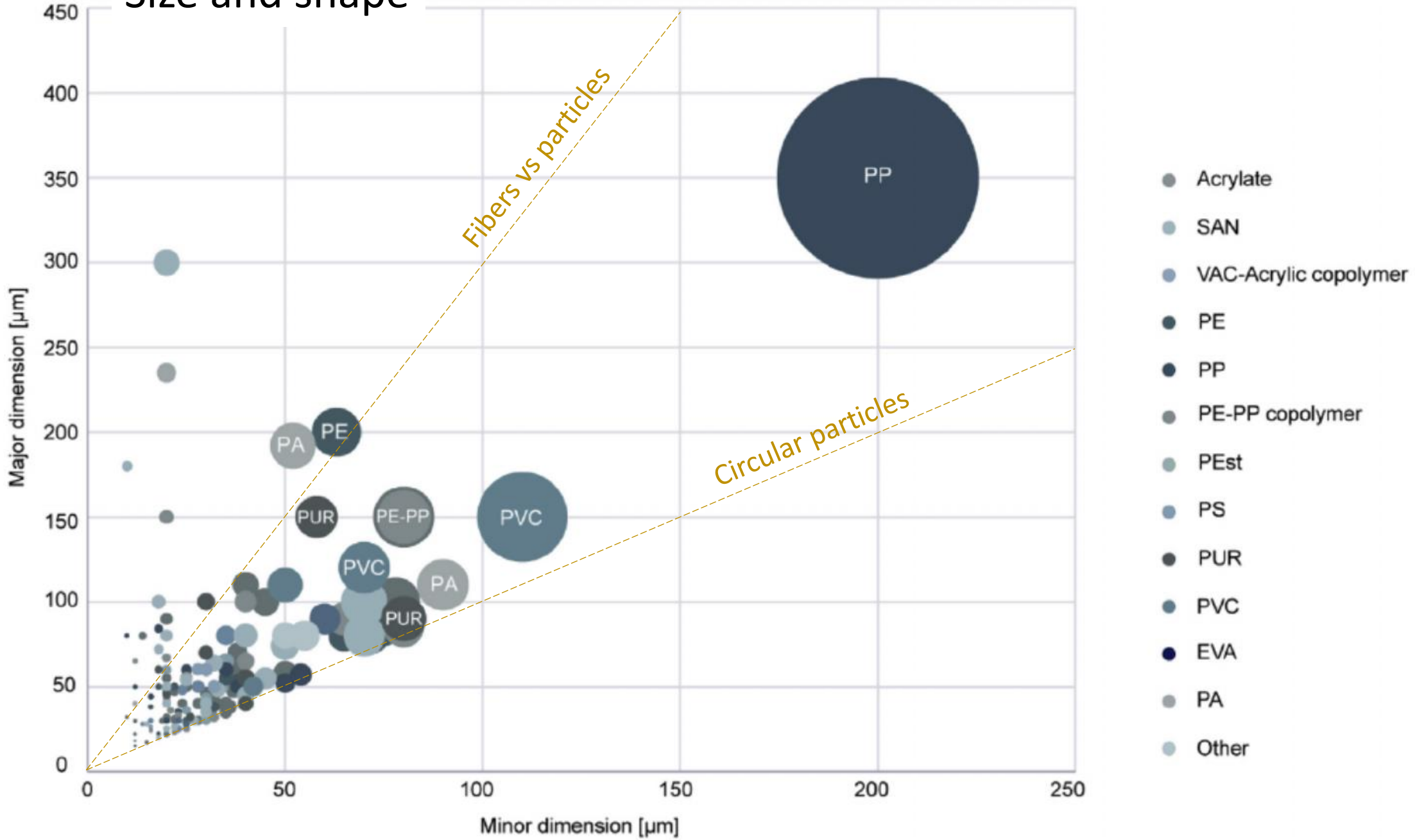
Raw wastewater, MP mass



Treated wastewater, MP mass

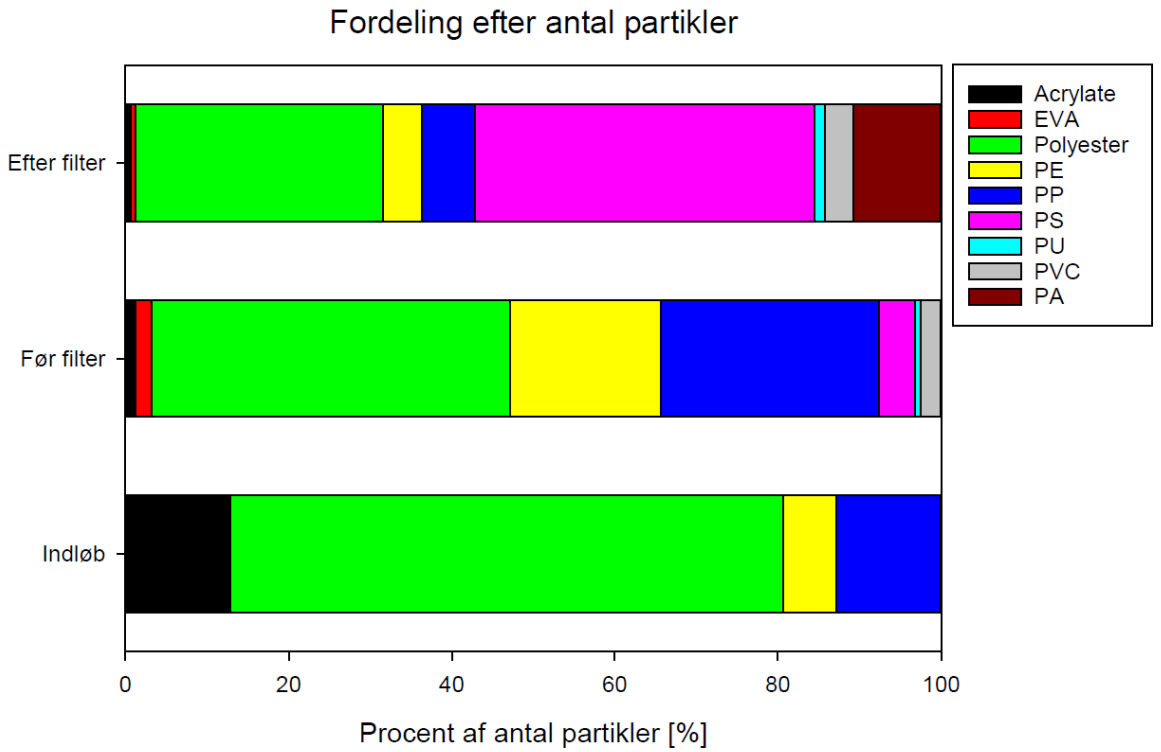


Size and shape



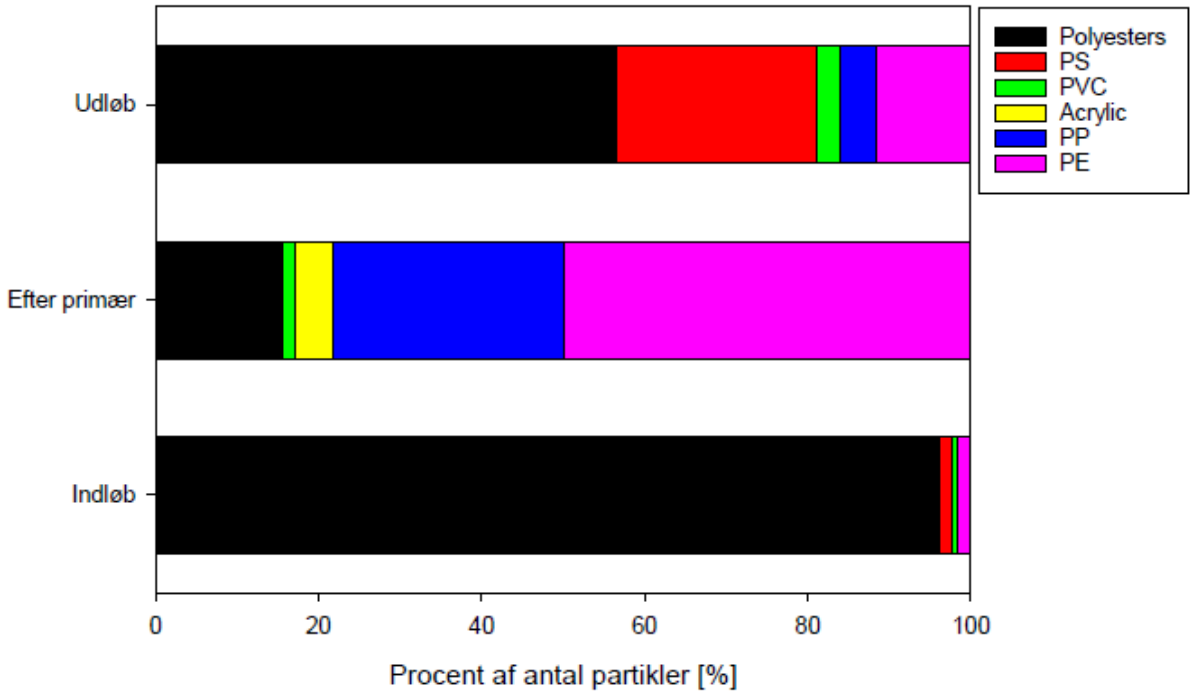
A drum filter polishing treated wastewater

	Indløb	Før skivefilter	Efter skivefilter
Antal [no/L]	98	25	4
Masse [µg/L]	1,99	0,26	0,081



Measurements at a primary settler

	Indløb	Efter primær	Udløb
Partikel antal [no/L]	567	6,14	2,90
Partikel masse [µg/L]	489	0,35	0,33



Summing up

Microplastics are present in raw wastewater, treated wastewater and stormwater

WWTPs are very efficient at retaining plastics

- Polishing technologies can further reduce the plastics
- Primary sedimentation is an important removal step

Stormwater from retention ponds contains microplastics at roughly the same concentration as treated wastewater

- We do not know how efficient stormwater ponds are at retaining microplastics

THANKS!