Great Lakes Microplastic Summit

Microplastics Sampling and Analysis

October 22nd 2025

Bijan Jafari

Microplastics Group Lead

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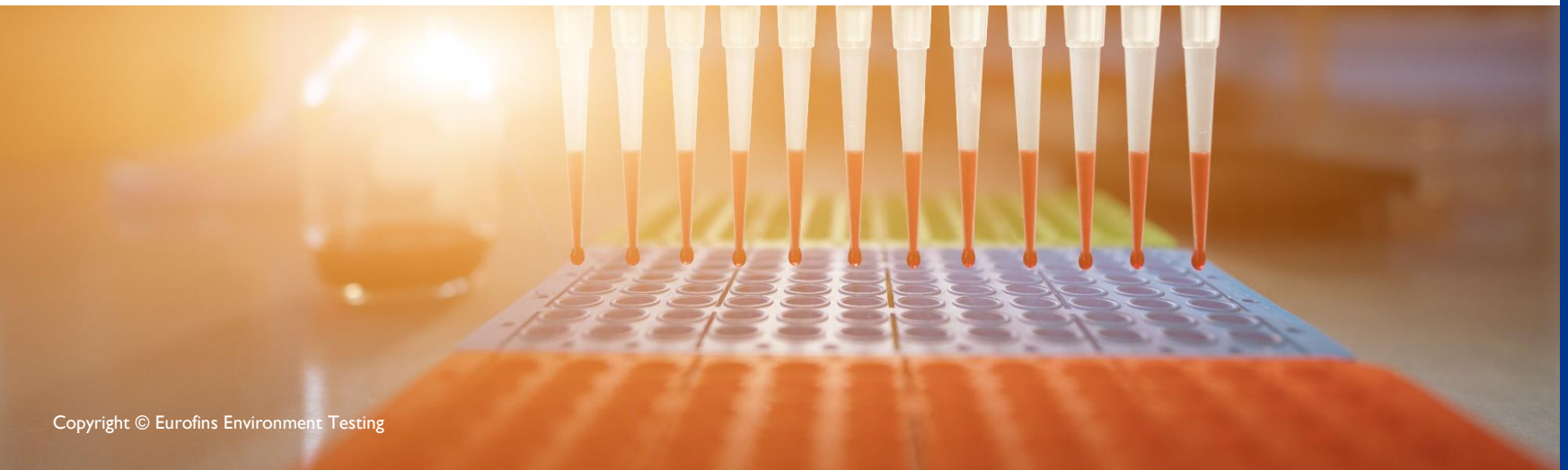
Bijan
Jafari

- Microplastic Group Lead



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What are Microplastics?

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What are Microplastics? (1 of 2)

1907

Leo Baekeland invented Bakelite, the first fully synthetic plastic

1972

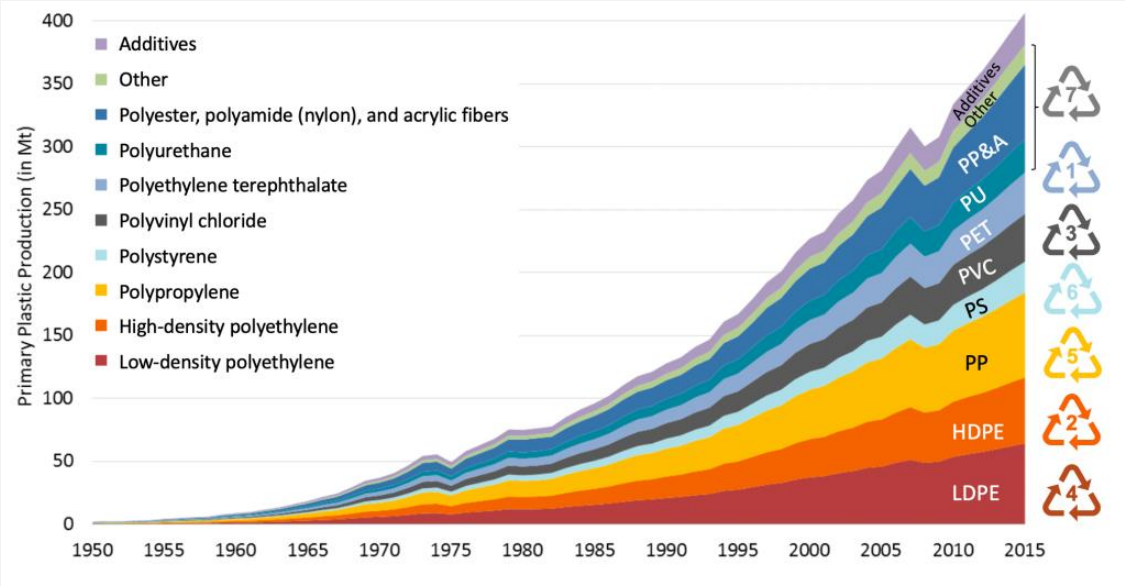
Plastic debris in the environment were first reported (Carpenter et al. 1972)

2019

WHO reported Microplastics in drinking water

2021

State Water Resources Control Board defines Microplastics in Drinking Water



From Geyer, 2020

"…solid **polymeric materials** to which **chemical additives** or other substances may have been added, which are particles which have at least **three dimensions** that are greater than **1 nm and less than 5,000 micrometres** (µm)…"

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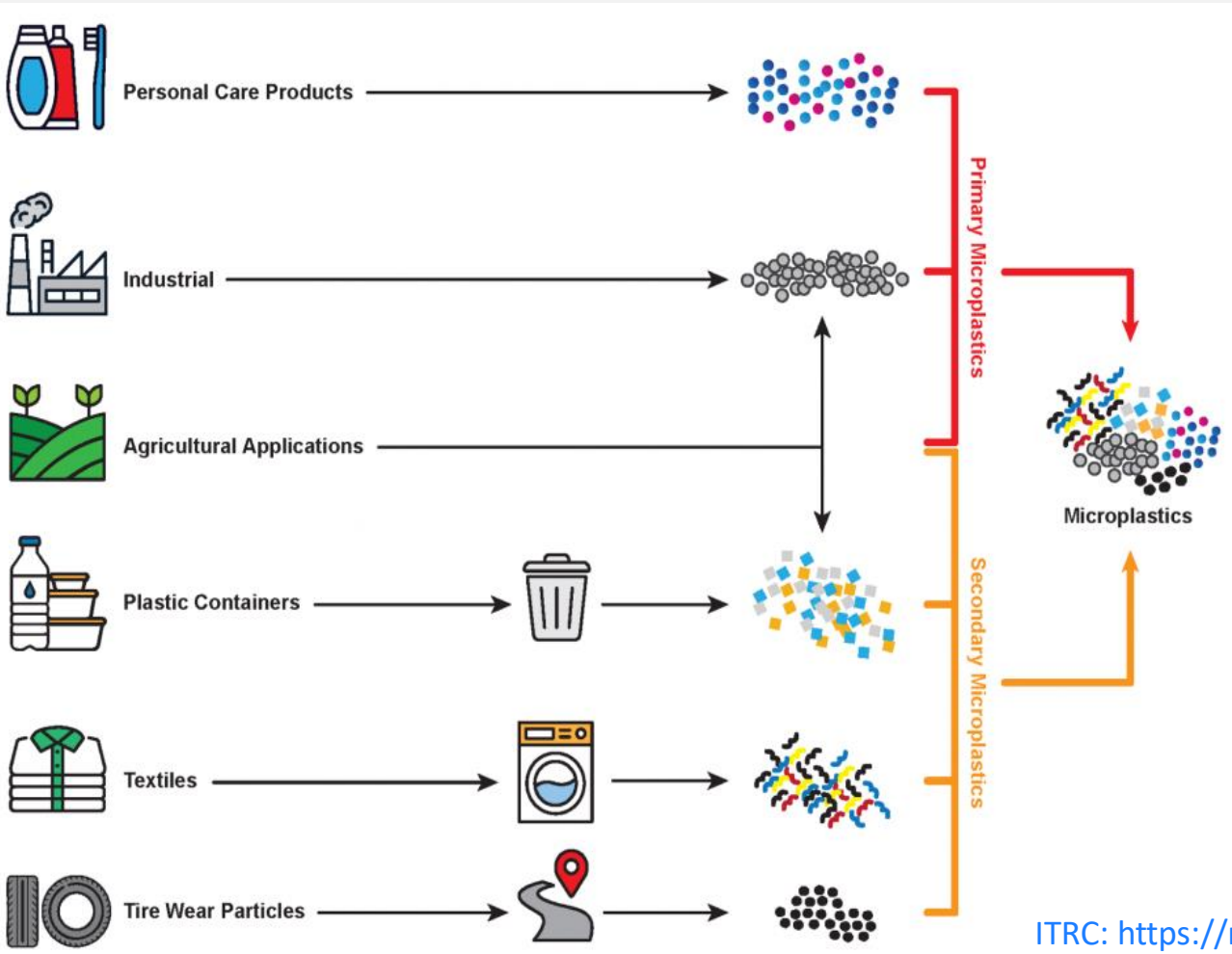
What are Microplastics? (2 of 2)



Our plastics Problem:

- 9.2 billion tons of plastics produced up until 2022

How do Microplastics end up in our environment?

1. There are also **intentionally added** Microplastics **(Primary Microplastics)**
2. Only less than 10 % recycled the rest landfilled or if mismanaged leaked into the environment as plastic never disappears; it just breaks down into smaller and smaller pieces called Microplastics **(Secondary Microplastics)**

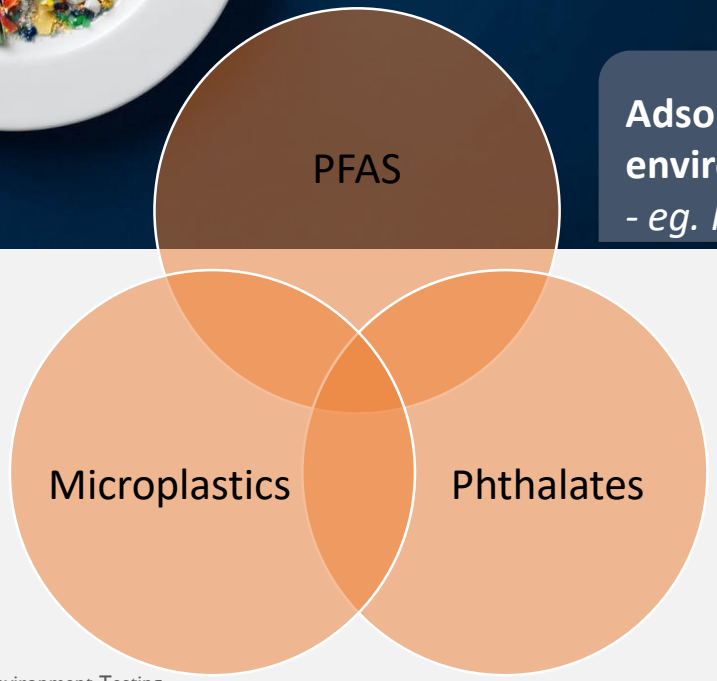
ITRC: https://mp-1.itrcweb.org/environmental-distribution-fate-and-transport/

Toxicity of Microplastics

Particles themselves
- physical hazard

Release unbound chemicals
- monomers or additives

Adsorbed chemicals from the environment
- eg. POPs



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Toxicity of Microplastics— continued

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Particle Size

Smaller — **Larger**

Molecular Damage (Translocation)

- Inflammation
- Reactive oxygen generation
- Neurological

Surface Area Dependent

Physical Damage

- Food Dilution
- Gastrointestinal obstruction
- Irritation/injury

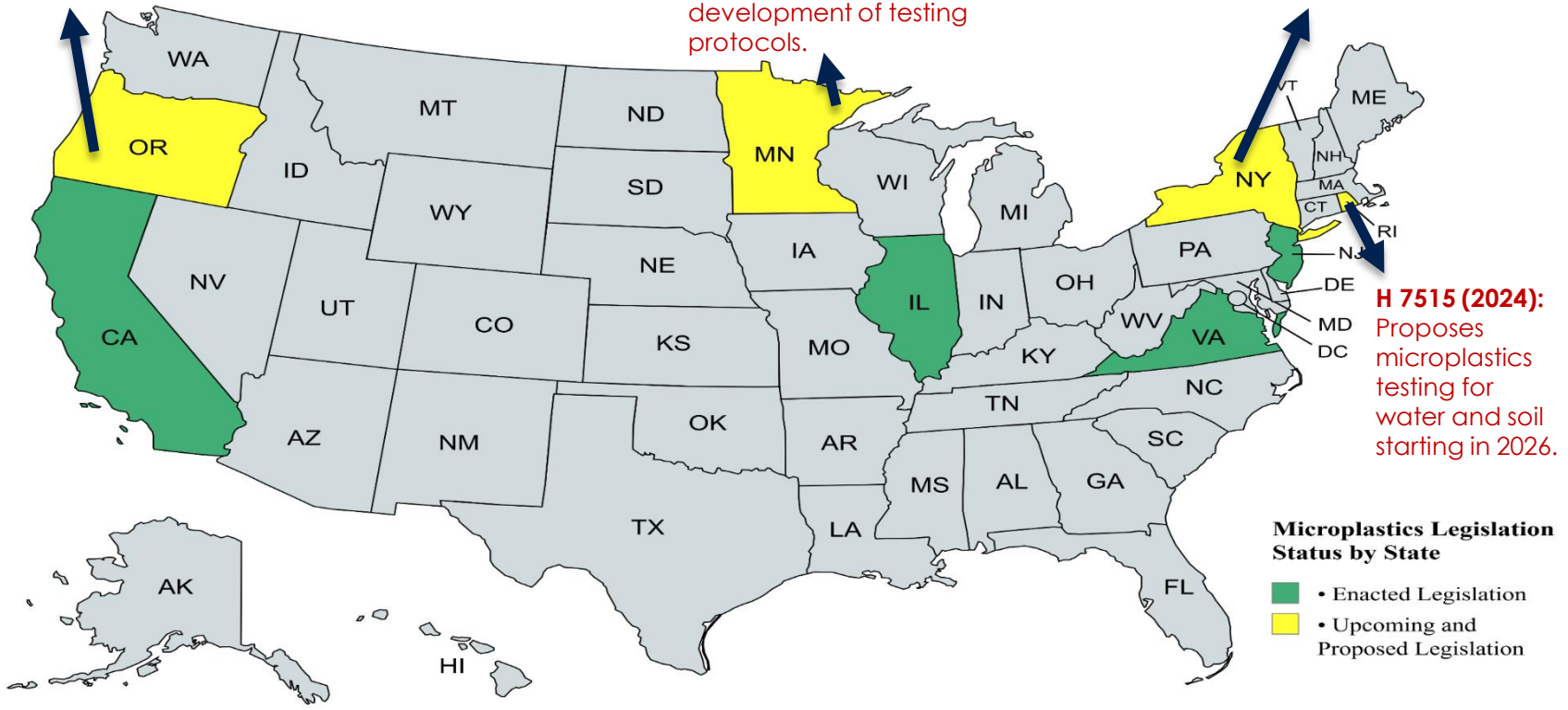
Volume Dependent

Legislations on Microplastics

SB 526 (2025): Proposes microfiber filters in new washing machines by 2030.

SF 2245 (2023): Defines microplastics and funds development of testing protocols.

Int 0692-2024: Would require the DEP to test drinking water for microplastics.



H 7515 (2024): Proposes microplastics testing for water and soil starting in 2026.

Passed Legislation

California:

- **SB 1422 (2018):** Sets definition and testing methods for microplastics in drinking water.
- **SB 1263 (2018**): Launches a statewide microplastics strategy.
- **SB 1147 (2023):** Requires health risk studies of microplastics in water.
- **AB 823 (2024):** Bans plastic microbeads in cosmetics, cleaning products, and coatings.

New Jersey:

- **A1816 (2014):** Bans microbeads in personal care products.

Virginia:

- **HB 33 (2024):** Creates a work group to study microplastics in drinking water.

Illinois:

- **SB 1563 (2023):** Requires draft testing regulations for microplastics in water by July 1, 2025.

Growing MP Capabilities

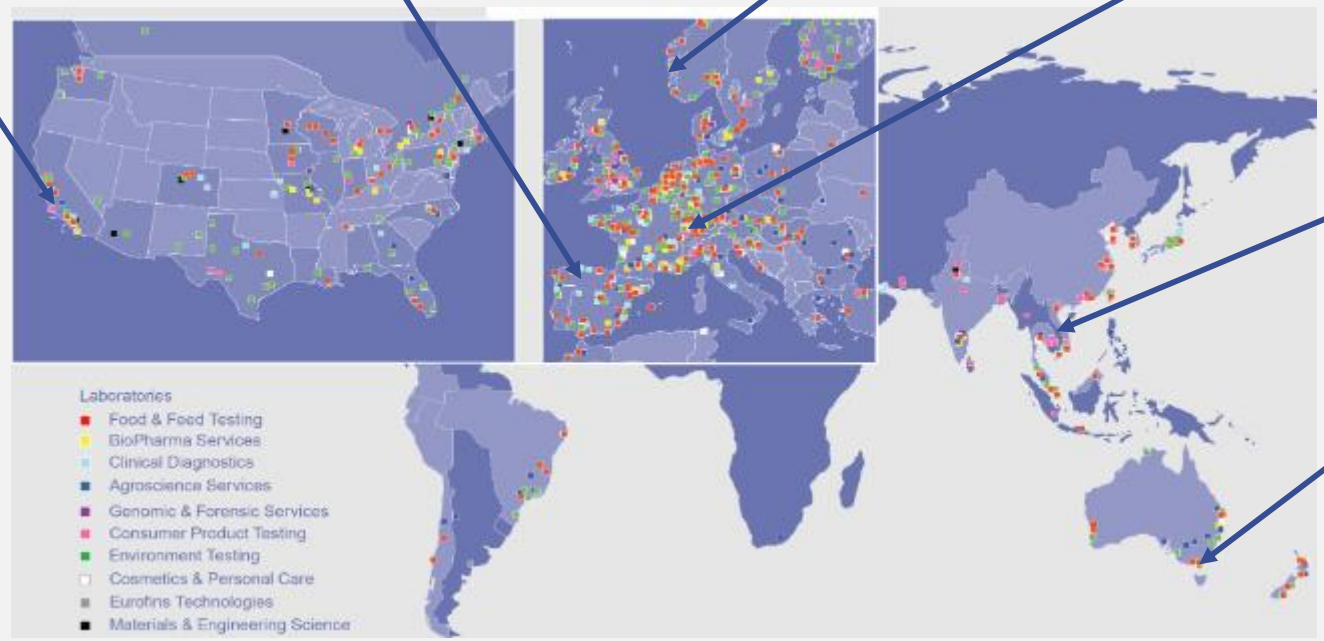
Our Network of Laboratories

Spain
TD-GC/MS
LDIR

Norway
PYR-GC/MS

Hungary
FTIR,
PYR-GC/MS

USA
Raman,
OPTIR



Vietnam
FTIR

Australia
LDIR,
PYR-GC/MS/MS

Matrices Tested

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Targets:

- Polyamide (PA)
- Polycarbonate (PC)
- Polyethylene (PE)
- Polyethylene Terephthalate (PET)
- Polymethyl Methacrylate (PMMA)
- Polypropylene (PP)
- Polyurethane (PU)
- Polyvinyl Chloride (PVC)
- Polystyrene (PS)

Environmental samples

Potable Water, Surface Water, Ground Water, Wastewater, Sewage, Soil, Biosolids, Compost, Biochar, Sand, Sediment, Air

Food and Food Products

Oysters, Mussels, Fish Tissue, Cheese, Milk, Salt, Infant Formula

Cosmetics and Personal Care Products

Creams, Body washes, Face and Body Scrubs,

Consumer Products

Eye Drops, Packaging Materials, Clothing, Washing Machine Effluent

How to Build a Microplastic lab?

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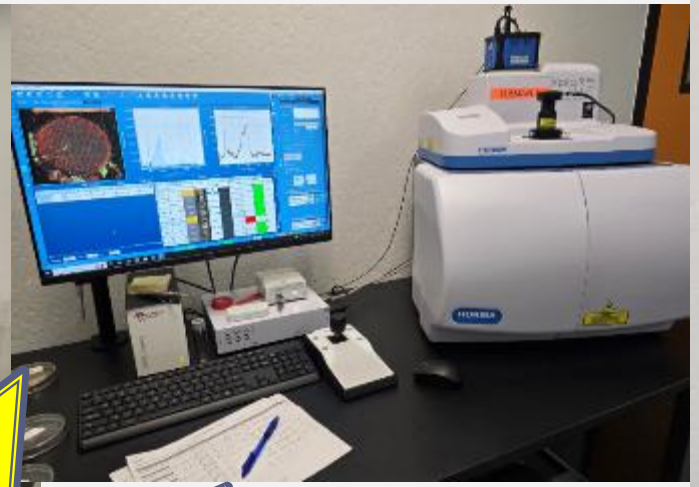
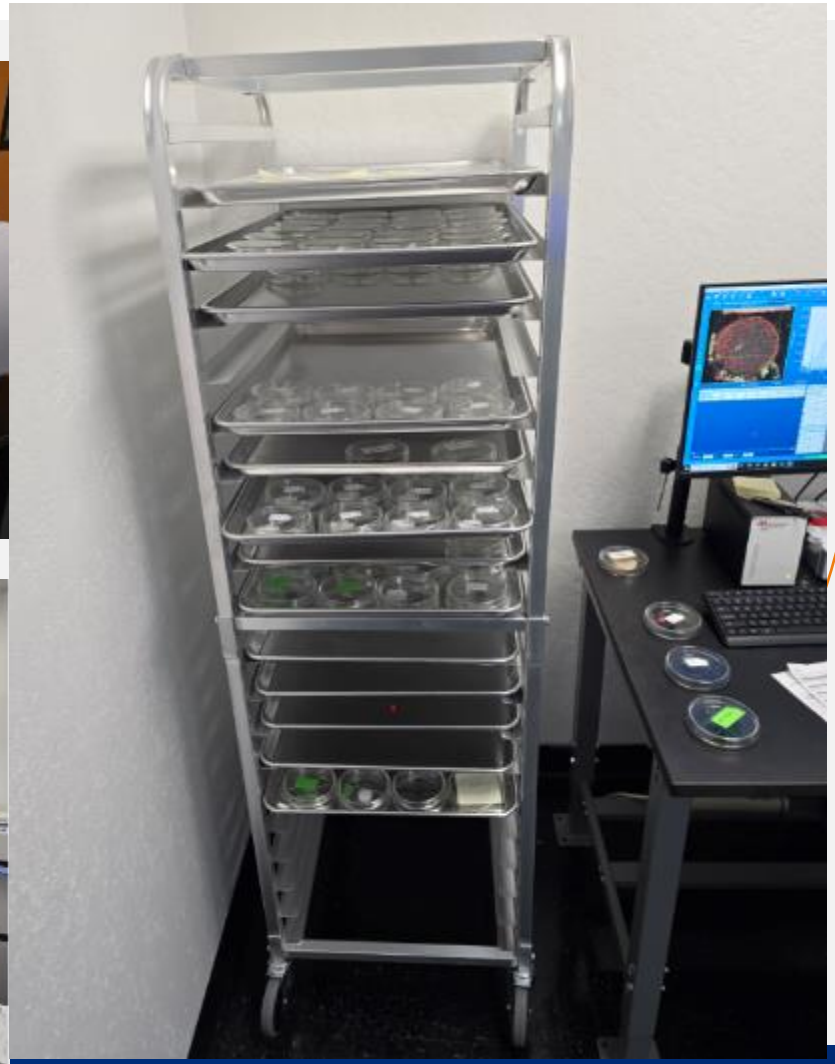
How It Started…

How It's Going…





TNI and ISO17025 and CA ELAP Accredited!

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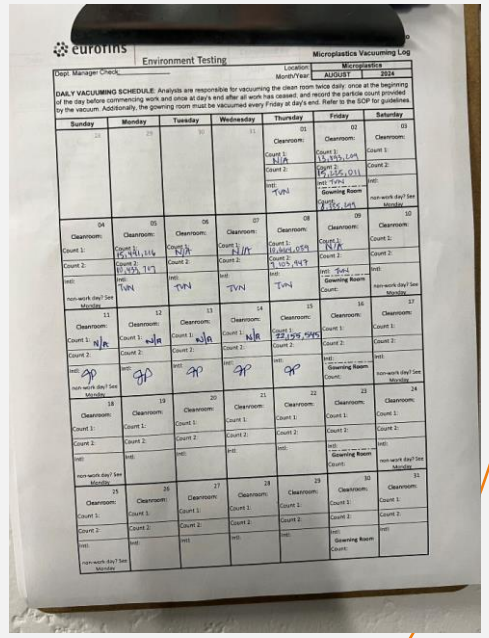
Engineering Controls



Microplastic Tool Belt

- Quality Control
  - Cleanroom
  - QA/QC Practices
- Instrumentation
  - Raman
  - O-PTIR
  - Next Generation Spectroscopy…?

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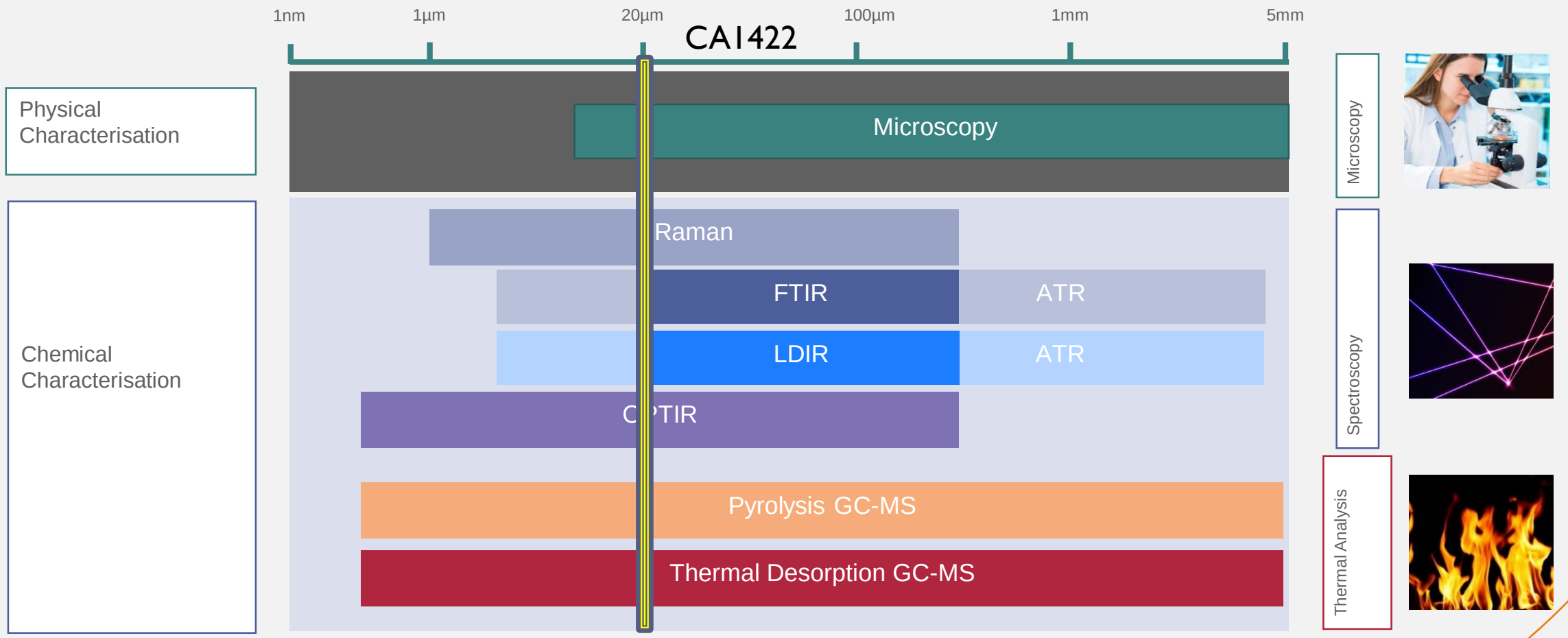
Methodologies



From BASEMAN (DELIVERABLE D4.3 Harmonized protocol for monitoring microplastics in biota)

How Raman Works

- **Laser Light Source**

A monochromatic laser (single color) is aimed at the sample.

- **Interaction with the Sample**

Most of the light bounces off with no energy change — this is called Rayleigh scattering.

- **Raman Scattering**

A very small amount of light changes energy due to vibrations in the molecules — this is Raman scattering, and it gives useful information about the sample.

- **Light Collection**

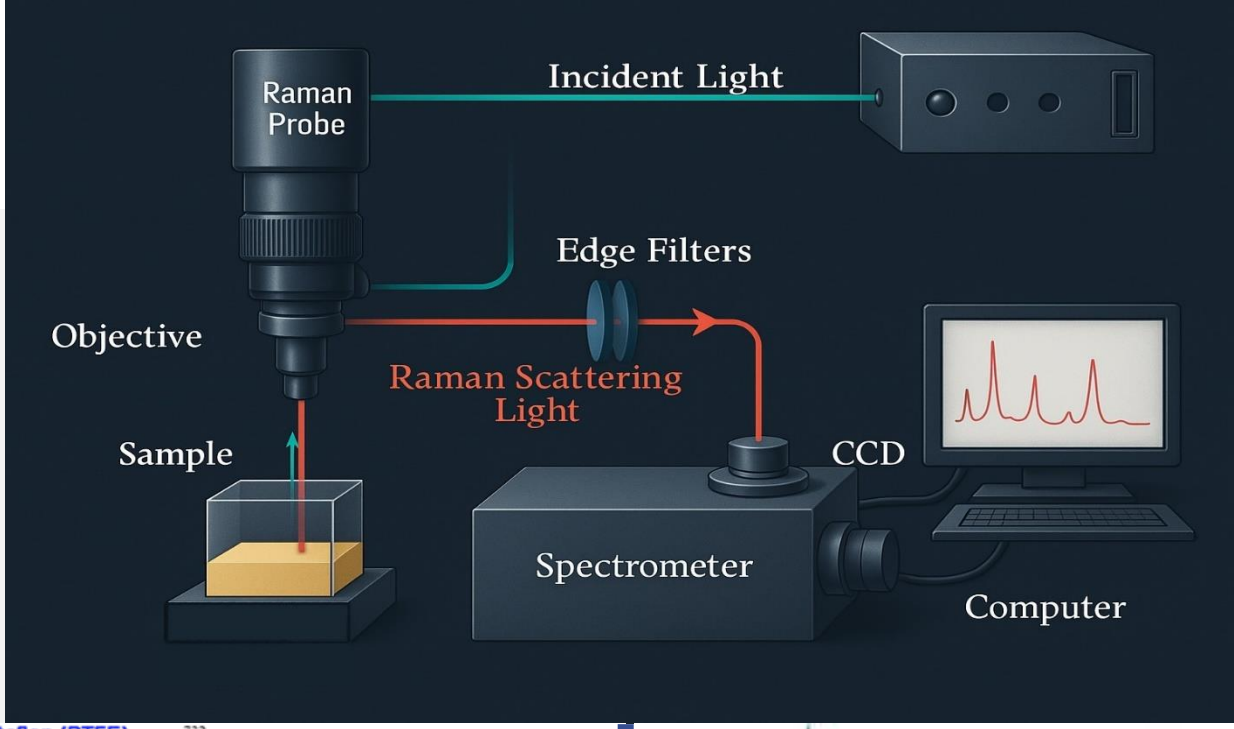
Both types of scattered light are collected using lenses or mirrors.

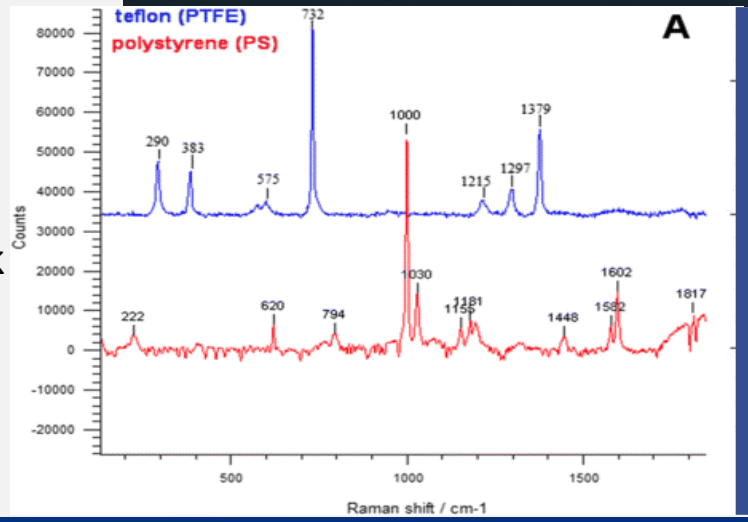
- **Filtering**

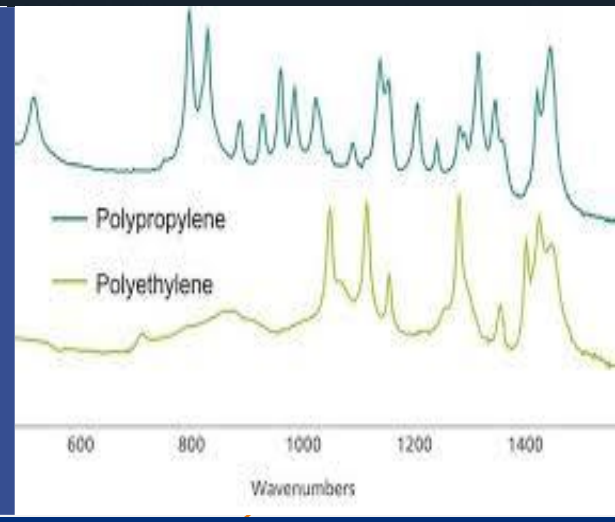
A filter removes the strong Rayleigh light so only the weak Raman signal is left.

- **Detection**

The Raman light goes to a detector (like a CCD), and a Raman spectrum is created from the data.

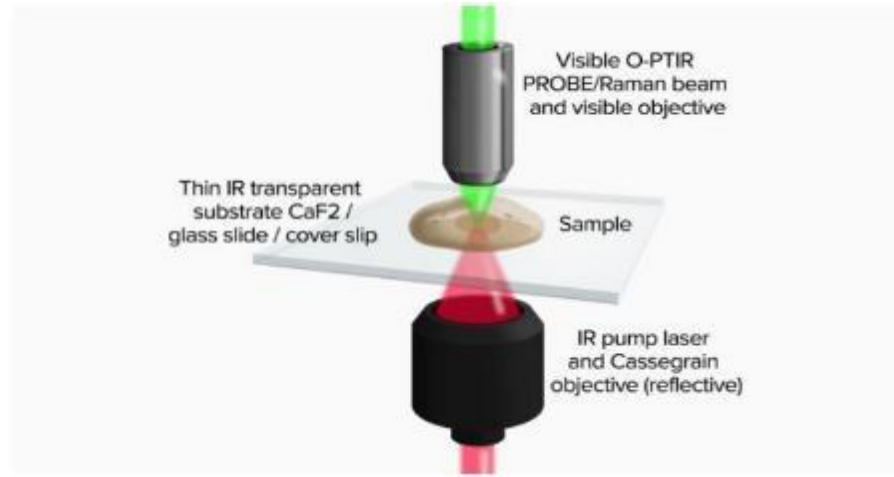






OPTIR

- Sub-500 nm spatial resolution – Essential for detecting nanoplastics.
- Counter-propagating laser setup – The IR laser comes from below, while the 532 nm probe laser comes from above, enhancing spatial resolution and sensitivity.
- Minimized background interference – Reduces optical artifacts for cleaner spectral data.
- Efficient detection of photothermal effects – The 532 nm laser detects tiny thermal expansions, allowing precise chemical identification.
- Simultaneous IR and Raman acquisition – Eliminates fluorescence interference and provides richer chemical data.
- Supports advanced filters – Including autofluorescence for enhanced contrast.



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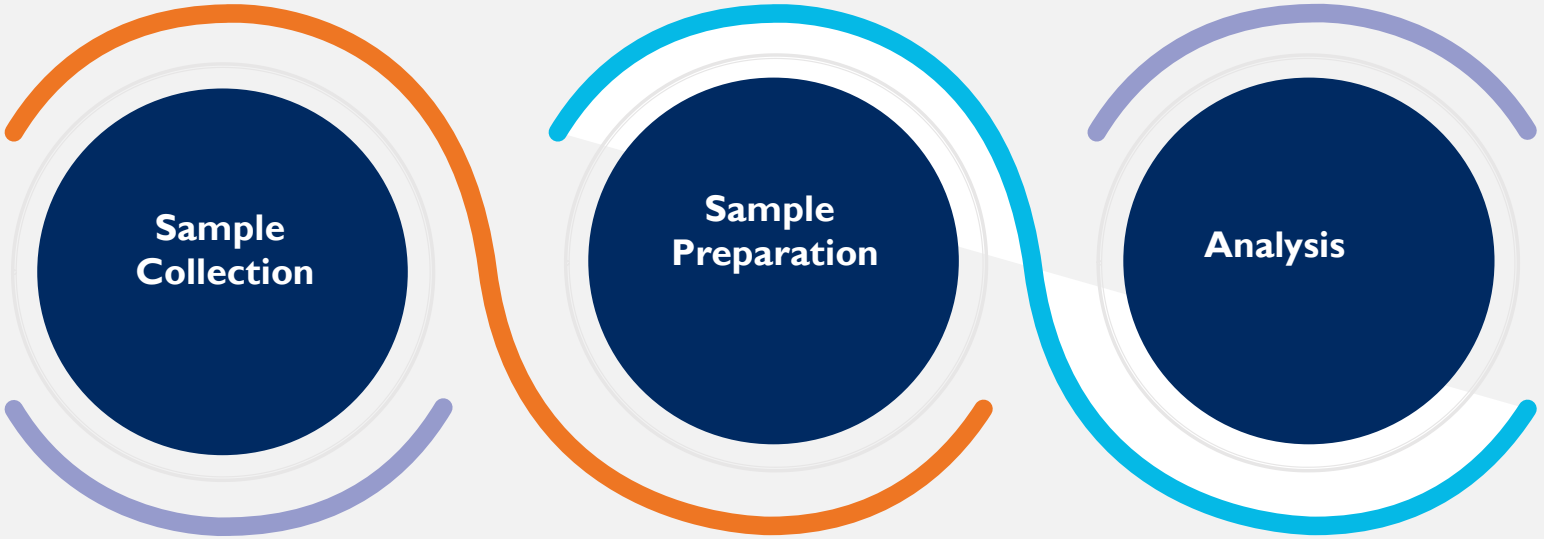
How are Microplastics analysed?

- Number
- Size
- Type
- Morphology
- Colour

How are Microplastics analysed?



ASTM INTERNATIONAL
Helping our world work better

ISO

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

How Do You Ship Samples?

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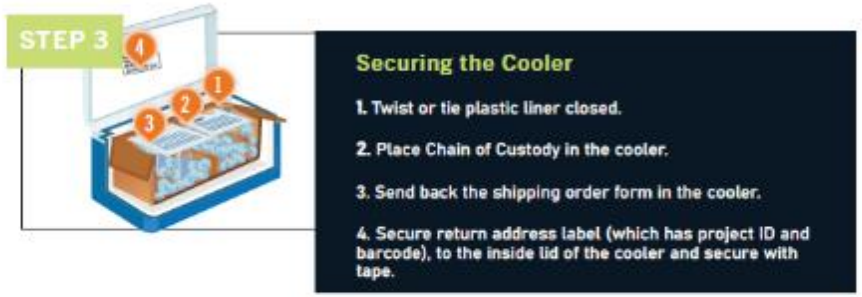
Microplastics Cooler Packing Instructions

For nonstandard samples or known hazards, please contact your project manager prior to shipping. All microplastic samples should be segregated into their own coolers for shipment back to the laboratory.

- **No ice needed**
- **Cardboard over plastic**
- **ALL samples are rinsed with MP-free water prior to extraction**

Microplastics Cooler Packing Instructions

Instructions for sending samples to Eurofins Environment Testing



Eurofins Environment Testing - Env.Marketing@ET.EurofinsUS.com - EurofinsUS.com/Env

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Typical Sampling Media- What do you get in the field?

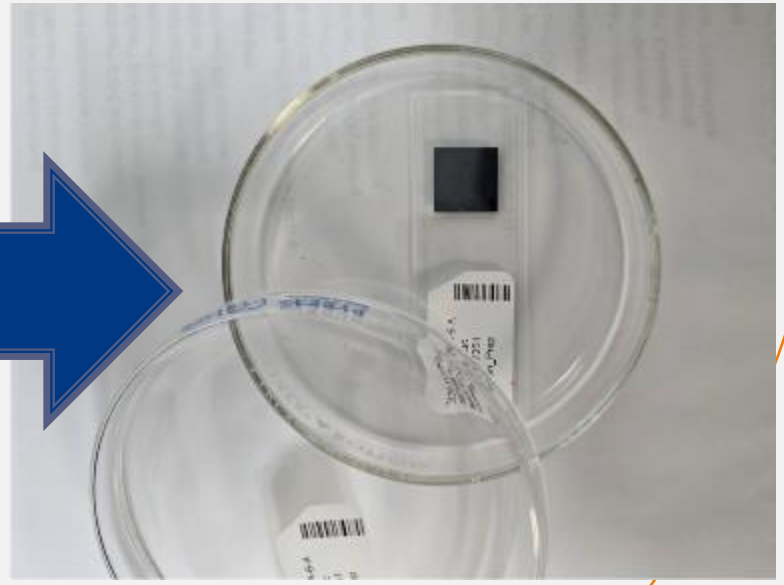
Pre-treated 1 liter bottle.

Metal Cap with Aluminum Foil Liner

Environmental Water

Consumer products in original packaging

Typical Aqueous Extraction



What Does a Report Look Like? (1 of 3)

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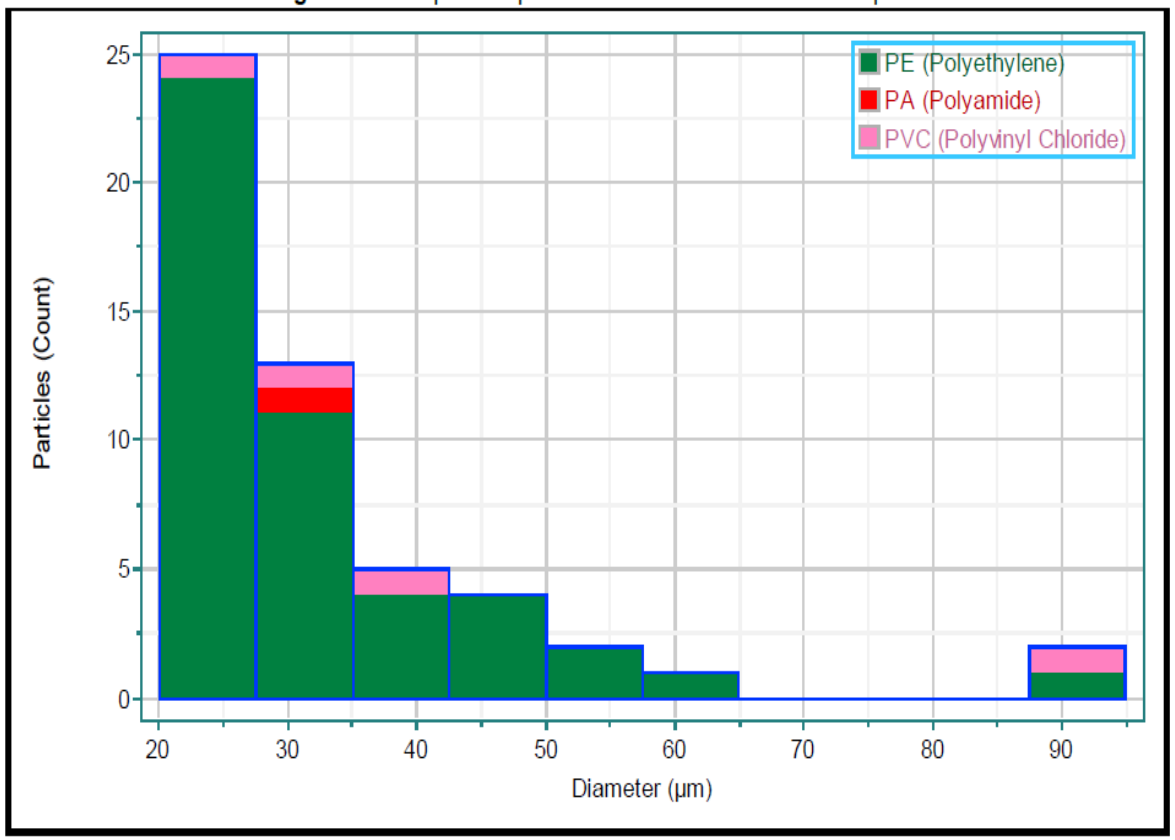
Eurofins Sacramento
Microplastics Analytical Report

Table 1: Total numbers of Microplastics Particles Detected

Client Sample ID:	[redacted]					
Matrix:	Water					
Lab Sample ID:	[redacted]					
Date Collected:	6/24/2025					
Date/Time Prepared:	7/02/2025 - 6:17					
Preparation Batch:	320-861019					
Date/Time Analyzed:	7/20/2025 - 14:21					
Analytical Batch:	320-861266					
Sample volume analyzed (mL):	996.4					
Microplastics	**Raw Result (#)**	**Unit**	**Final Result (#)**	**RL**	**MDA**	**Unit**
Polyethylene (PE)	47	Particles	47	20	10	MPs/L
Polypropylene (PP)	0	Particles	<MDA	20	10	MPs/L
Polystyrene (PS)	0	Particles	<MDA	20	10	MPs/L
Polyvinyl Chloride (PVC)	4	Particles	<MDA	20	10	MPs/L
Polyethylene Terephthalate (PET)	0	Particles	<MDA	20	10	MPs/L
Polycarbonate (PC)	0	Particles	<MDA	20	10	MPs/L
Polymethyl Methacrylate (PMMA)	0	Particles	<MDA	20	10	MPs/L
Polyamide (PA)	1	Particles	<MDA	20	10	MPs/L
Polyurethane (PU)	0	Particles	<MDA	20	10	MPs/L
Polytetrafluoro Ethylene (PTFE)	0	Particles	<MDA	20	10	MPs/L
Total	52	Particles	47			MPs/L

Figure 1: Microplastics particle size distribution in the sample



*The size distribution chart is generated based on the raw results obtained from the analysis.

What Does a Report Look Like? (2 of 3)

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Eurofins Sacramento
Microplastics Analytical Report

Table 2: Method Blank Results

Lab Sample ID:	MB 320-844874
Matrix:	Water
Date/Time Prepared:	4/09/2025 - 8:00
Preparation Batch:	320-844874
Date/Time Analyzed:	4/11/2025 - 7:38
Analytical Batch:	320-845455
Volume analyzed (mL):	1000

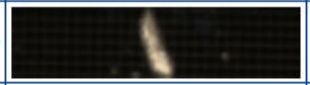
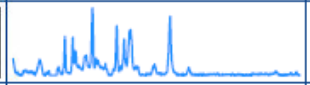
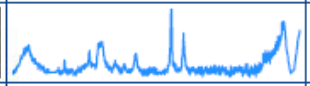
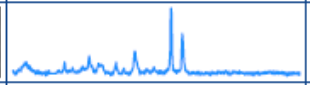
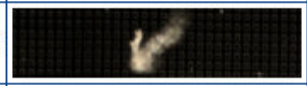
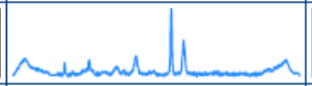
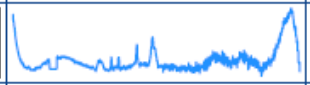
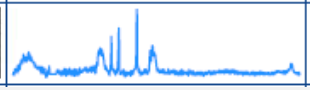
Microplastics	MB Result	BDL	RL	MDA	Unit
Polyethylene (PE)	1	8.7	20	10	MPs/L
Polypropylene (PP)	0	3.0	20	10	MPs/L
Polystyrene (PS)	0	3.0	20	10	MPs/L
Polyvinyl Chloride (PVC)	0	3.0	20	10	MPs/L
Polyethylene Terephthalate (PET)	0	3.0	20	10	MPs/L
Polycarbonate (PC)	0	3.0	20	10	MPs/L
Polymethyl Methacrylate (PMMA)	0	3.0	20	10	MPs/L
Polyamide (Nylon 6) (PA)	0	3.0	20	10	MPs/L
Polyurethane (PU)	0	3.0	20	10	MPs/L
Polytetrafluoro Ethylene (PTFE)	0	3.0	20	10	MPs/L
Total	1				MPs/L

Table 3: Laboratory Control Sample Results

Lab Sample ID:	LCS 320-844874
Matrix:	Water
Date/Time Prepared:	4/09/2025 - 8:05
Preparation Batch:	320-844874
Date/Time Analyzed:	4/11/2025 - 8:09
Analytical Batch	320-845455
Volume analyzed (mL):	1000

Analyte	Spike Added	LCS Result	Unit	%Rec	%Rec Limits
Polyethylene; 20-27 µm	50	32	MPs/L	64	50-150
Poly (Methyl Methacrylate) 212-250 µm	10	9	MPs/L	90	50-150

What Does a Report Look Like? (3 of 3)

	Diameter	Image	Spectrum	Family	Class	HQI
Filter Min					0	
Filter Max						
√ 1	49.9			SACRAMENTO	PC (Polycarbonate)	98.4
√ 2	54.1			SACRAMENTO	PET (Polyethylene Terephth...	65.4
√ 3	34.3			SACRAMENTO	PET (Polyethylene Terephth...	71.5
√ 4	37.9			SACRAMENTO	PET (Polyethylene Terephth...	87.8
√ 5	63.1			SACRAMENTO	PET (Polyethylene Terephth...	90.1
√ 6	22.4			SACRAMENTO	PA (Polyamide)	68.7
√ 7	21.4			SACRAMENTO	PE (Polyethylene)	60.6
√ 8	21.4			SACRAMENTO	PE (Polyethylene)	63.5
√ 9	26.7			SACRAMENTO	PE (Polyethylene)	64.9
√ 10	32.9			SACRAMENTO	PE (Polyethylene)	67.2
√ 11	46.6			SACRAMENTO	PE (Polyethylene)	72.6

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Real-World examples!

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A Water Bottle Story: Stress Testing & Microplastics (1 of 4)

Shaking

Heat

UV

Capping

Handling

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Why Test Bottled Water (2 of 4)

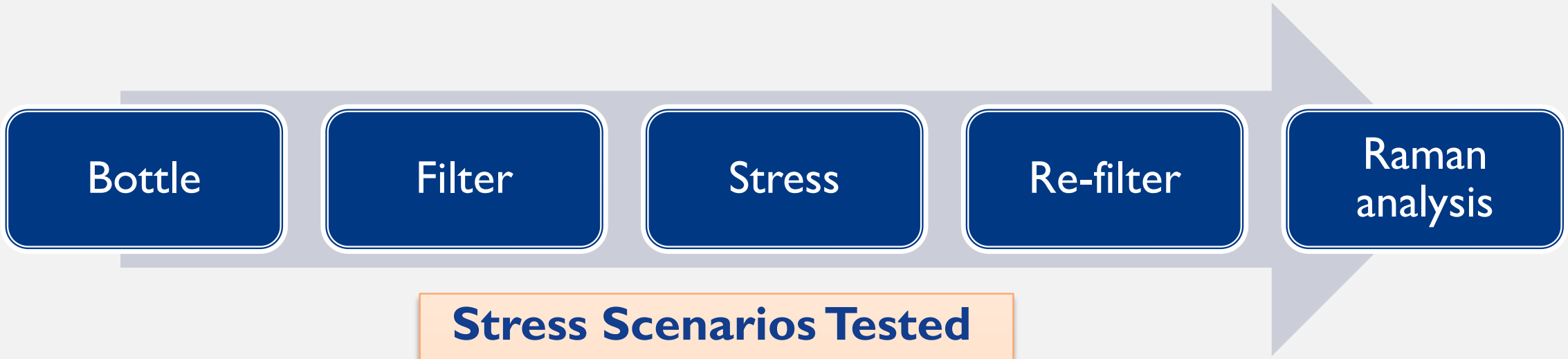
Why

- Bottled water is widely consumed
- Consumers handle, reuse, and store bottles in various ways
- Regulations & research usually focus on water content, less on *packaging* behavior

Limitations

- Only one bottle brand tested
- No replicates (one bottle per scenario)
- Pilot design, not regulatory-level data
- A starting point, not a final conclusion

How We Designed the Study (3 of 4)



Stress Scenarios Tested

- Hand-pressing ×10 (handling)
- Open/close cap ×10 (capping)
- Shaking ×100 (running/workout)
- UV exposure 2 days (sunlight)
- Heat exposure 2 days (in-car)

Microplastics Released Under Everyday Stress (3 of 4)

Handling

- PE surged 14 → 203. PET appeared.

Capping

- PET increased 7 → 17

Shaking

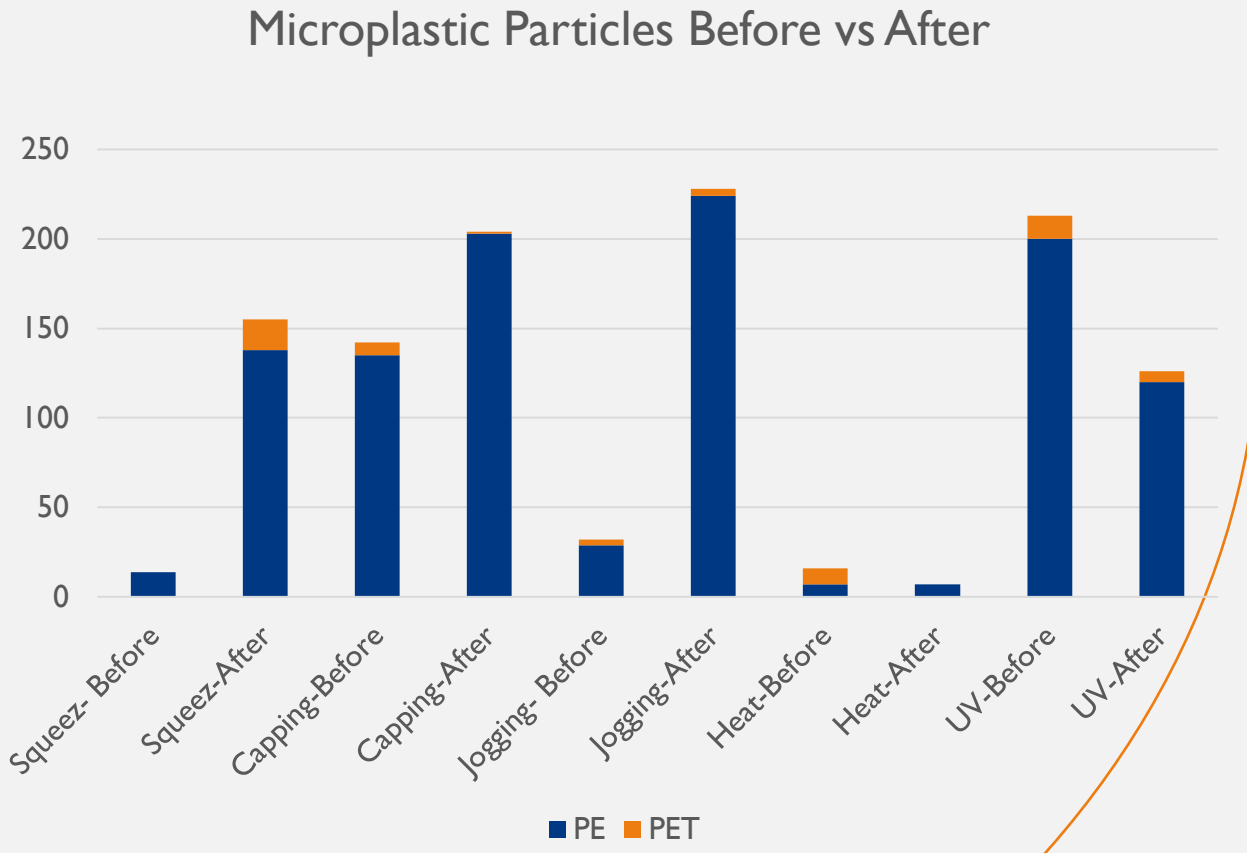
- PE jumped 29 → 224 (largest effect).

Heat

- Totals dropped (16 → 7). Possible adhesion or fragmentation <20 µm.

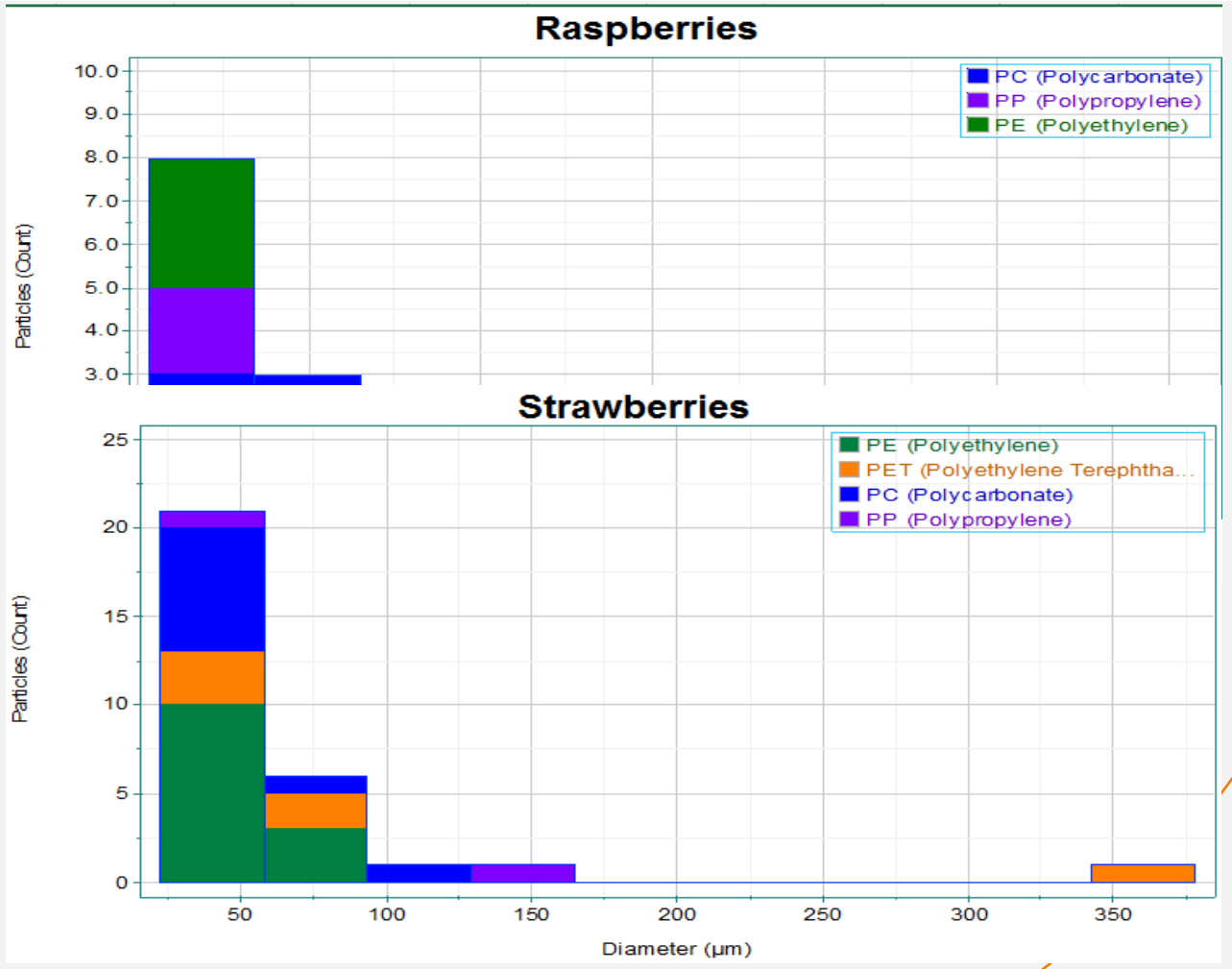
UV

- Totals decreased (217 → 128). Suggests UV degradation into sub-20 µm fraction.

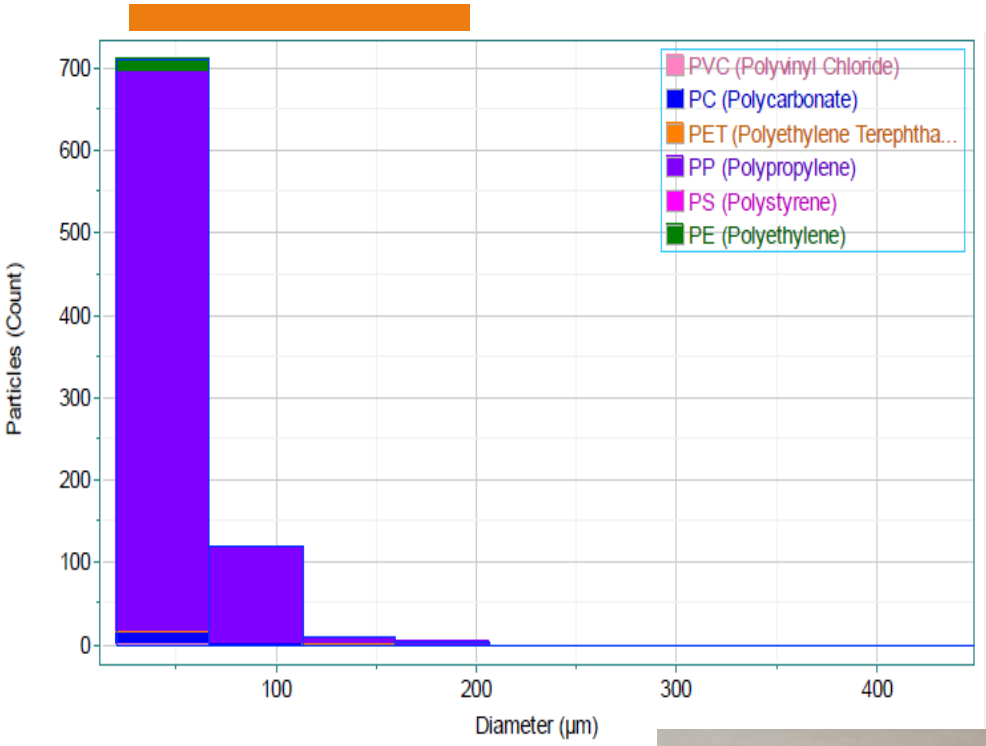


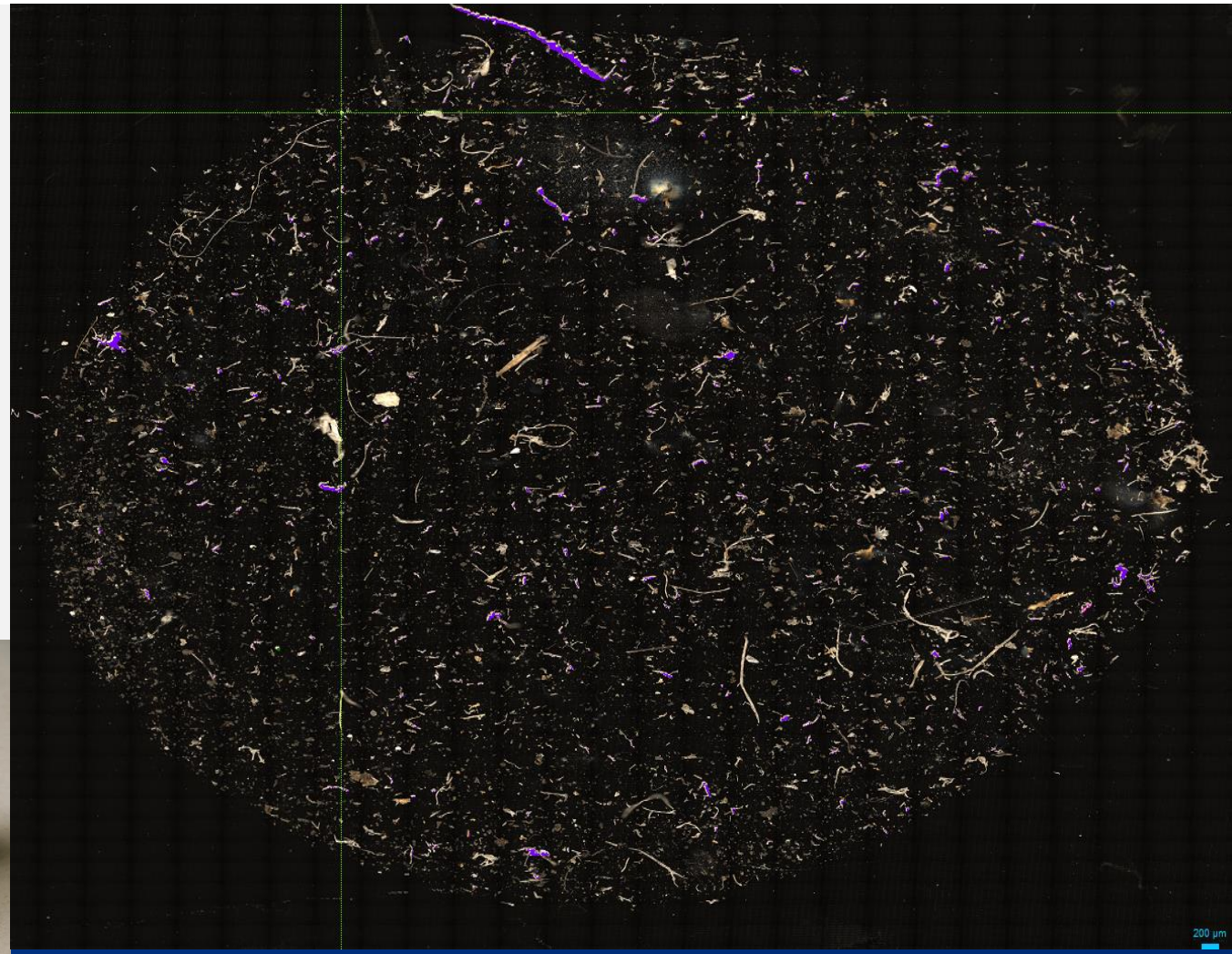
Detection of Microplastics in Packaged Fresh Berries

- Two berry types (raspberry and strawberry) were analyzed for microplastics. ~40g of each were taken from clamshell plastic containers.
- Raman spectroscopy was used to detect particles in the 20–500 µm range.
- The raspberry sample contained 16 particles, mainly Polycarbonate (PC) and Polyethylene (PE).
- The strawberry sample had 30 total particles, with PE as the most abundant polymer, followed by PET, PC, and PP.
- A blank sample showed a background of 7 particles, including 3 PE, 2 PET, and 2 PC, serving as a control to monitor potential contamination during analysis.
- Most particles were observed in the 20–80 µm size range.
- Polymers detected included: PE, PET, PC, PP



Findings in a Can of Beer





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What Comes Next?

Consumer & Market Shifts

- Demand for "microplastics-safe" products
- Natural fibers & biodegradable alternatives
- Eco-labels and consumer pressure

Global Action

- UN Plastics Treaty includes microplastics
- REACH Annex XVII Entry 78 Compliance
- Circular economy focus: design for recovery
- Wastewater & large-scale capture solutions

Shifting from awareness → accountability → action