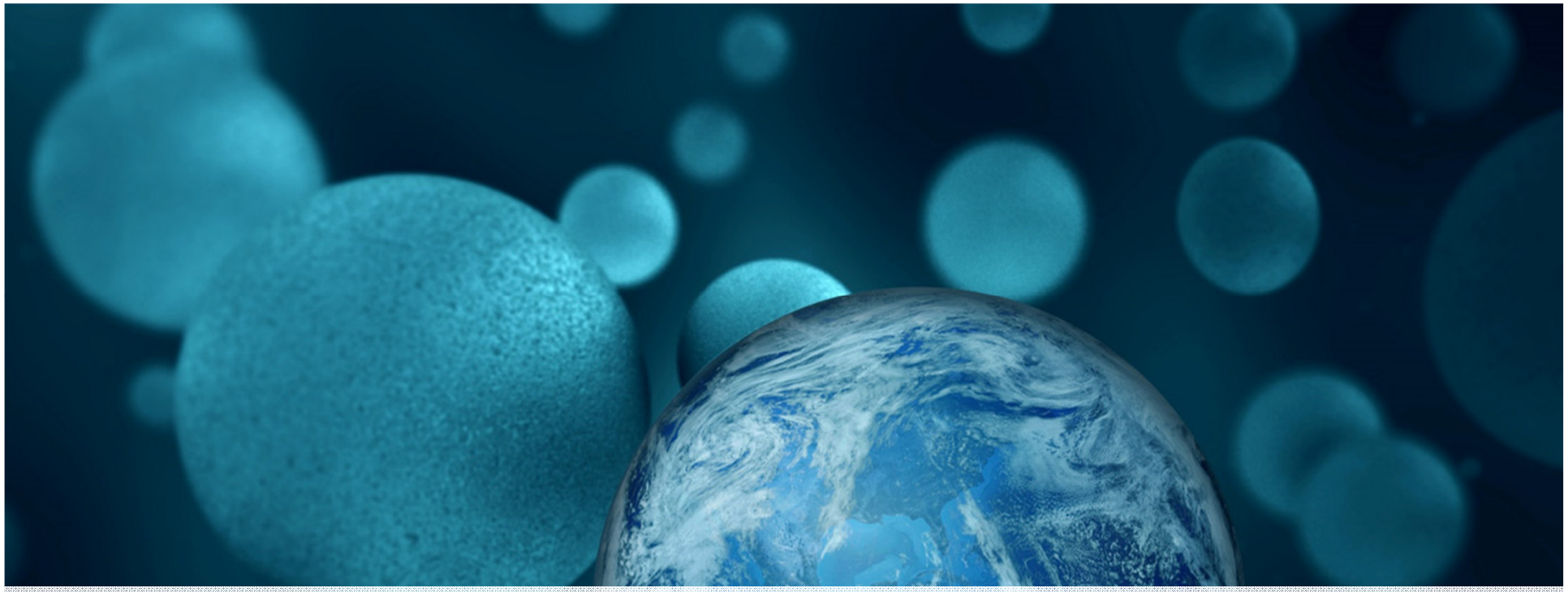

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Micro Plastics in Marine Environment in Beverages and in Food, our Analyzer Solutions

Massimiliano Rocchia
European Business Development Manager Molecular Spectroscopy

Materials and Structural Analysis
Molecular Spectroscopy & Material Characterization

Executive summary

2019

ECHA re-define Microplastic

Microplastic is a material composed of solid polymer-containing particles, to which additives or other substances may have been added, with particle dimensions ranging from 1 nm to 5 mm and with fiber lengths ranging from 3 nm to 15 mm and length to diameter ratio of >3

Studies conducted in the last few years have shown that microplastics are found extensively in seafood but not only: A variety of other foods are contaminated such as drinking water, beer, honey, table salt, soft drink etc…
Last year a study, conducted by the Medical University of Vienna, found microplastics in human stools for the first time increasing the global concern.

Microplastics comes from multiple sources:

- **Cosmetic and personal-care**, such as scrubbing cream, tooth paste and exfoliates
- **Synthetic fibres** coming from clothing and textiles production for domestic and industrial uses
- **Food chains**
- Abrasion of **car tyres**
- etc…

.

https://www.theguardian.com/environment/2018/mar/15/microplastics-found-in-more-than-90-of-bottled-water-study-says

Executive summary

Microplastics are “small plastics” that pollute the environment. The first and widely accepted definition of Microplastics, done according to their size, comes back to 2008 during the first International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris. The **National Oceanic and Atmospheric Administration (NOAA)** classifies microplastics as plastic particles smaller than 5 mm.

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Microplastics – Who are they?

- A microplastic is a small piece of plastic
- How much small?
  - 5mm to 1 micron
- Common microplastics
  - PE, PP, PET
- Sources
  - Primary
    - Particles designed to be small (ie: cosmetic microbeads)
  - Secondary
    - Formed from the breakdown of larger items

Name	Abbreviation
Expanded Polystyrene	EPS
Polypropylene	PP
Polyethylene	PE
Acrylonitrile-butadiene-styrene	ABS
Polystyrene	PS
Polyamide (Nylon)	PA
Polymethyl methacrylate	PMMA
Polycarbonate	PC
Cellulose Acetate	CA
Polyvinyl chloride	PVC
Polyethylene terephthalate	PET
Polytetrafluoroethylene	PTFE

2017
IUNC (International Union for Conservation of Nature)

Synthetic clothes from washing machines (35%), tyre wear (28%), urban dust (24%)

Why they are a concern and must be monitor

Microplastics can be a vehicle for several chemicals of concern like Bisphenol A (**BPA**), Heavy metals, **Phthalates** and more general Persistent Organic Pollutants **POPs** .

BPA is one of the most studied chemicals found in plastic. It is usually found in plastic packaging or food storage containers and can leak out into food. Some evidence has shown that BPA can interfere with reproductive hormones, especially in women (*1).

Phthalates, a type of chemical used to make plastic flexible, have been shown to increase the growth of breast cancer cells. However, this research was carried out in a petri dish, so the results can't be generalized to humans (*2).

POPs are a class of chemicals that remain in the environment and have harmful effects on the human health such as pesticides (DDT), industrial chemicals such as polychlorinated biphenyls (PCB) etc…

A recent study examined the effects of microplastics in laboratory mice.
When fed to mice, the microplastics accumulated in the liver, kidneys and intestines, and increased levels of oxidative stress molecules in the liver. They also increased the level of a molecule that may be toxic to the brain (*3).

To **avoid the consumption of Microplastics** a test should be done to measure if there are Microparticles present and to identify the founded Microparticles as microplastics or not.

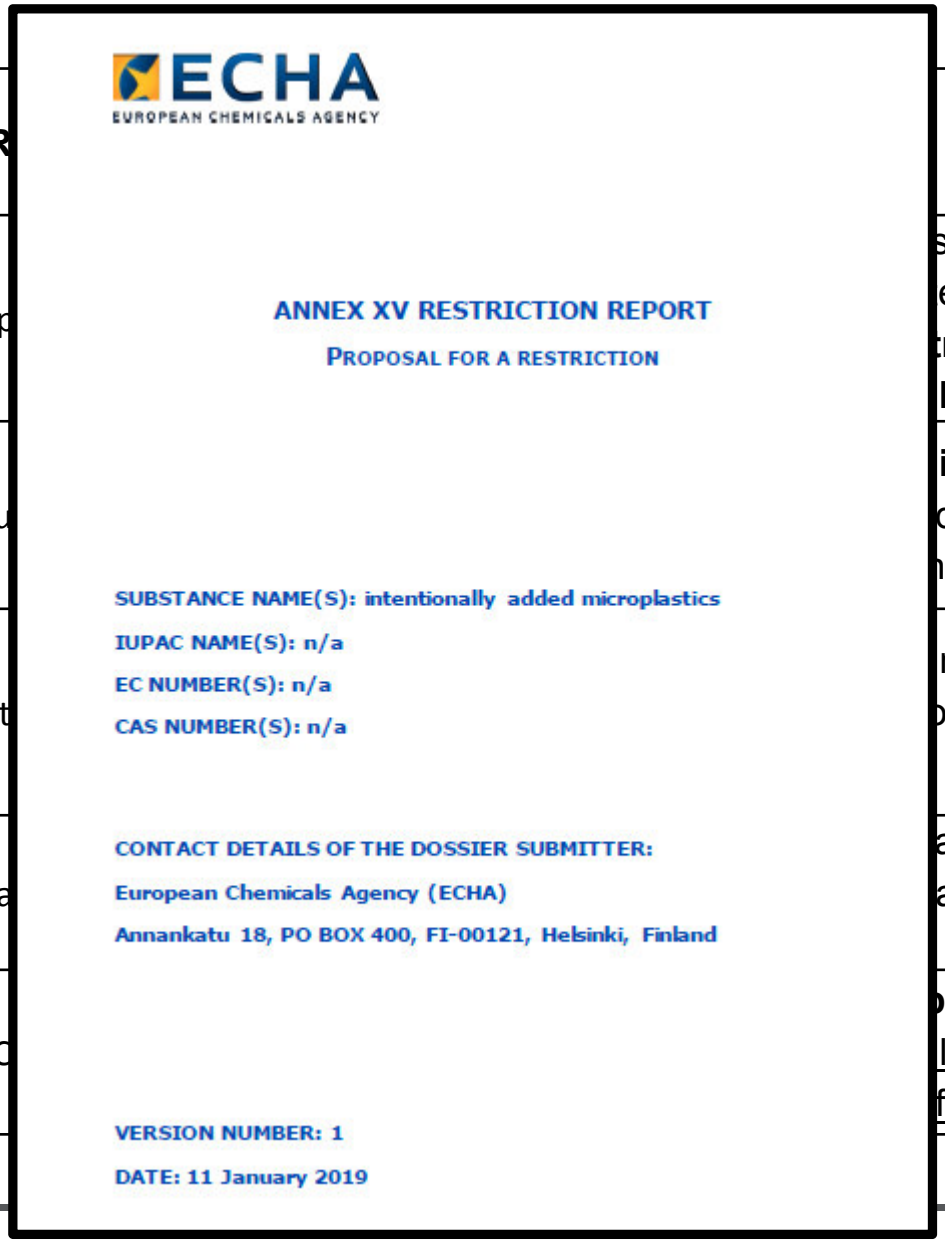
*1 https://www.ncbi.nlm.nih.gov/pubmed/23994667
*2 https://www.ncbi.nlm.nih.gov/pubmed/22049059
*3 https://www.ncbi.nlm.nih.gov/pubmed/28436478

Regulatory Landscape – What is happening around the world

Region	Key Regulatory bodies	Status
European Union	European Commission, REACH	- EC currently passing laws with guidance to ban microbeads - EC has committees in place to set testing standards for industry (**Registration, Evaluation, Authorisation & restriction of Chemicals REACH))**
South Korea	Ministry of Environment (MoE)	- **MoE banned microbeads from cosmetics** - Has funded academic and government research labs to better understand problem
United States	EPA, FDA	- No major announcements or regulation - Supports and hosts working groups for industry toxicology researchers
California	California Legislature	- Passed clean water law in 2018 which launched initiative to develop microplastic testing methods
Canada	C-EPA	- **Banned microbeads** - Only major regulatory body to list FTIR as key method for molecular identification of microplastics

Regulatory Landscape – What is happening around the world

R	Status
Europ	ssing laws with guidance to ban microbeads ees in place to set testing standards for **tration, Evaluation, Authorisation &** **hemicals REACH))**
Sou	**icrobeads from cosmetics** demic and government research labs to nd problem
Unit	ncements or regulation osts working groups for industry toxicology
Ca	ater law in 2018 which launched initiative to astic testing methods
C	**beads** latory body to list FTIR as key method for fication of microplastics



ECHA
EUROPEAN CHEMICALS AGENCY

ANNEX XV RESTRICTION REPORT

PROPOSAL FOR A RESTRICTION

SUBSTANCE NAME(S): intentionally added microplastics

IUPAC NAME(S): n/a

EC NUMBER(S): n/a

CAS NUMBER(S): n/a

CONTACT DETAILS OF THE DOSSIER SUBMITTER:

European Chemicals Agency (ECHA)

Annankatu 18, PO BOX 400, FI-00121, Helsinki, Finland

VERSION NUMBER: 1

DATE: 11 January 2019

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What you need to know analyzing Microplastics

- Common questions
  - How much (Load)?
  - What type (Identity)?
  - Which dimension/shape (Sizing)?
- Identity/dimension/Shape of plastic is related to:
  - Source
  - Potential Toxicity

- Technique used to identify material depends on:
- Particle Size
- Information Required
  - Identity
  - Particle Size
  - Size Distribution
  - Number of particles to be analyzed

Which Tecniques are sutiable for Microplastics Analysis

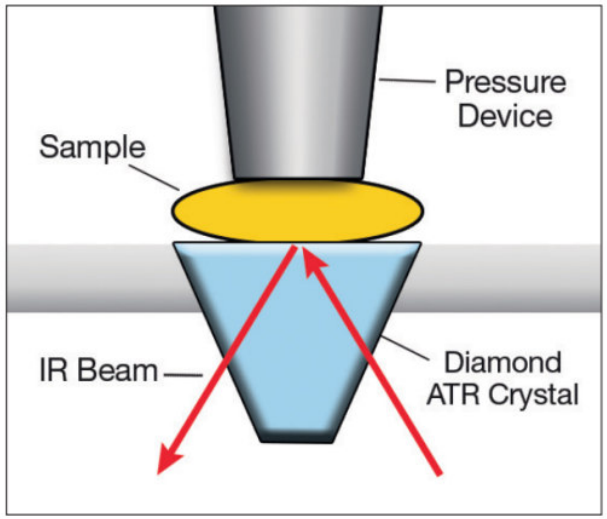
Infrared and Raman Spectroscopy & Microscopy

	FTIR + ATR	FTIR + Small Spot ATR	Point-and-Shoot FTIR Microscope	FTIR Imaging Microscope	Raman Imaging Microscope
Configuration					
	Nicolet iS5 FTIR Spectrometer and iD7 ATR Accessory	SurveyIR Microspectroscopy Accessory + Nicolet iS5 FTIR Spectrometer	Nicolet iN5 IR Microscope + Nicolet iS20 FTIR Spectrometer	Nicolet iN10 MX IR Imaging Microscope	DXR2 Raman Microscope
Measurable Particle Size					
5 mm	✓				
1 mm	✓	✓			
500 µm	✓	✓			
100 µm		✓	✓	✓	
10 µm			✓	✓	✓
1 µm					✓

Solution for

Particles in the mm range

Larger Samples: FTIR with Single-Bounce ATR



- Visible to naked eye
- Manipulated with tweezers
- Microscopy not required
- FTIR + ATR frequently used in this case

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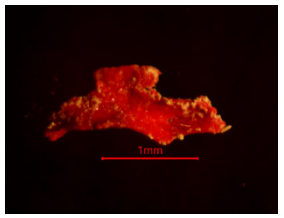
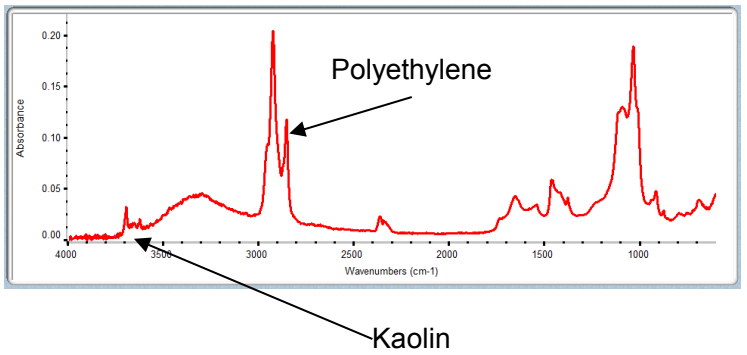
Microplastics and Marine Life

1. Scat samples obtained from Gray Seals in Cape Cod
2. Microplastic particles obtained during filtering / washing of samples
3. Particles identified using FTIR with ATR

Christine A Hudak and Lisa Sette

Center for Coastal Studies, Provincetown, MA, USA





Solution for

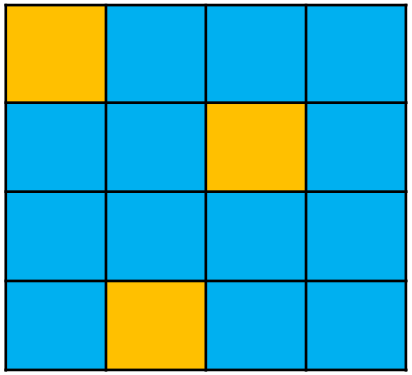
Particles in the micron and sub-micron range

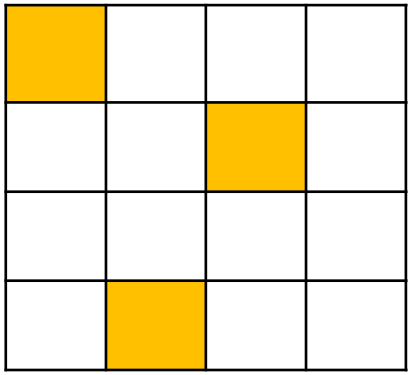
Micro spectroscopy

- Particle sizes below 100 microns require micro spectroscopy
  - To visualize the sample
  - To focus the spectrometer beam to a suitably small size
- Microscopy has two benefits
  - The ability to measure small particles
  - The ability measure multiple particles automatically
- Both FTIR and Raman are available in microscope configurations

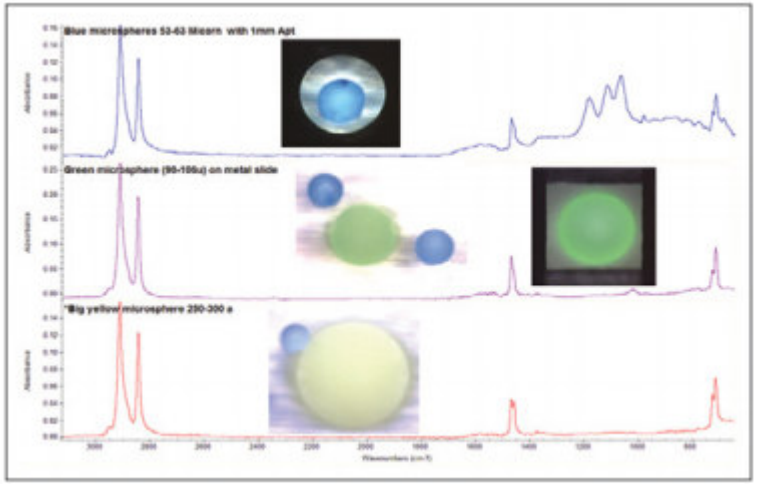
Data Collection Options

- Single point
  - Only a single point is collected
- Imaging
  - Contiguous data points are acquired to provide a chemical map of an area
- Multiple-point
  - Many discrete particles are analyzed in sequence





Single Point Analysis: Microbeads



- Exfoliant microbeads obtained from person care formulation
- Beads are 100-25 microns in size
- Using and IR microscope equipped with an ATR objective, the particles were identified as polyethylene
- Simple ‘point-and-shoot’ analysis

Application Feasibility Results

To avoid the consumption of Microplastics a methodology is developed based on 2 Techniques: **Raman-Microscopy and FTIR-Microscopy**.

Analysis workflow

Step 1

- Bottled Water
- Beverages
- Ocean water
- Sand
- Mud

Sampling

- H_2O_2
- Enzyme treatment & Digestion
- …

Sample pre-treatment

- Alumina filter
- Silicon Filter
- Cellulose gold-coated filter
- …

Filtration

Step 2

iN10MX

- **DXR2** i Raman Microscope
- **iN10MX** FTIR Microscope

Measure

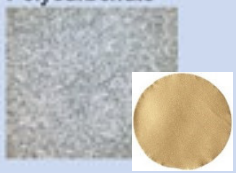
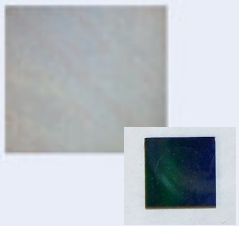
DXR2xi

- Optical identification
- Chemical identification
- Quantification (number & size)

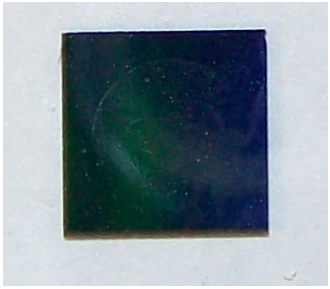
Analyze

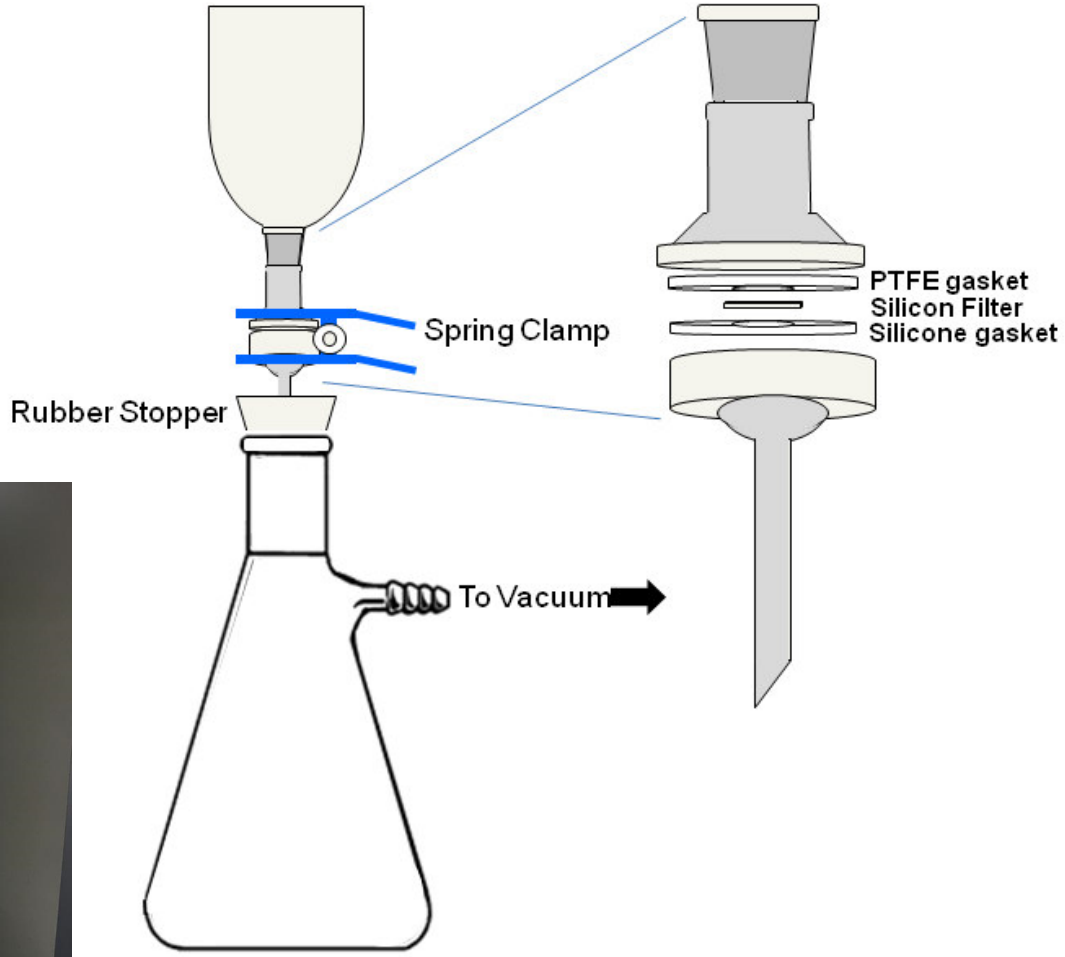
www.thermofisher.com/microplastics

Filters Tested

Filter Type	Advantages	Disadvantages	FTIR	Raman
Gold coated Polycarbonate 	Readily available Can be used with filter apparatus without gaskets	Does not lay flat Highly reflective surface may hinder contrast (particle recognition) Expensive	Good choice for reflection	Possible to see polycarbonate peaks through gold Some broad baseline offset with some lasers
Silver 	All metal Less expensive than gold coated	More rigid than gold coated PC More of a textured surface at high magnification More reactive surface - reported problems with pH of carbonated water	Reasonable for reflection – less reflective than gold	Some spectral artifacts from filters themselves (highest with 20X but less at higher magnification)
Al_2O_3 	Readily available More rigid Transmitted light possible if intense enough Less expensive option	Delicate – easily broken Visual images – contrast an issue – surface not clearly defined. Some features on surface that might be detected as particles	Can be used in transmission but limited to > 1250 cm^{-1} Some spectral peaks and some variation in peaks over the filter. Reflection weak	Some Raman spectral contributions from the filters – broad features Baseline offsets Laser light transmits through
Silicon 	Rigid Good visible images	Square Needs gasket development Fragile Expensive	Transmission Some variation across filter (filter background: (Si-O)) – broad baseline offset Reflection not as good as gold but possible	Silicon peaks

Filtration Kit





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Possible Approach ➔ Scan full filter

Analyzes with FTIR-Microscopy. Microplastic down to 10 micron

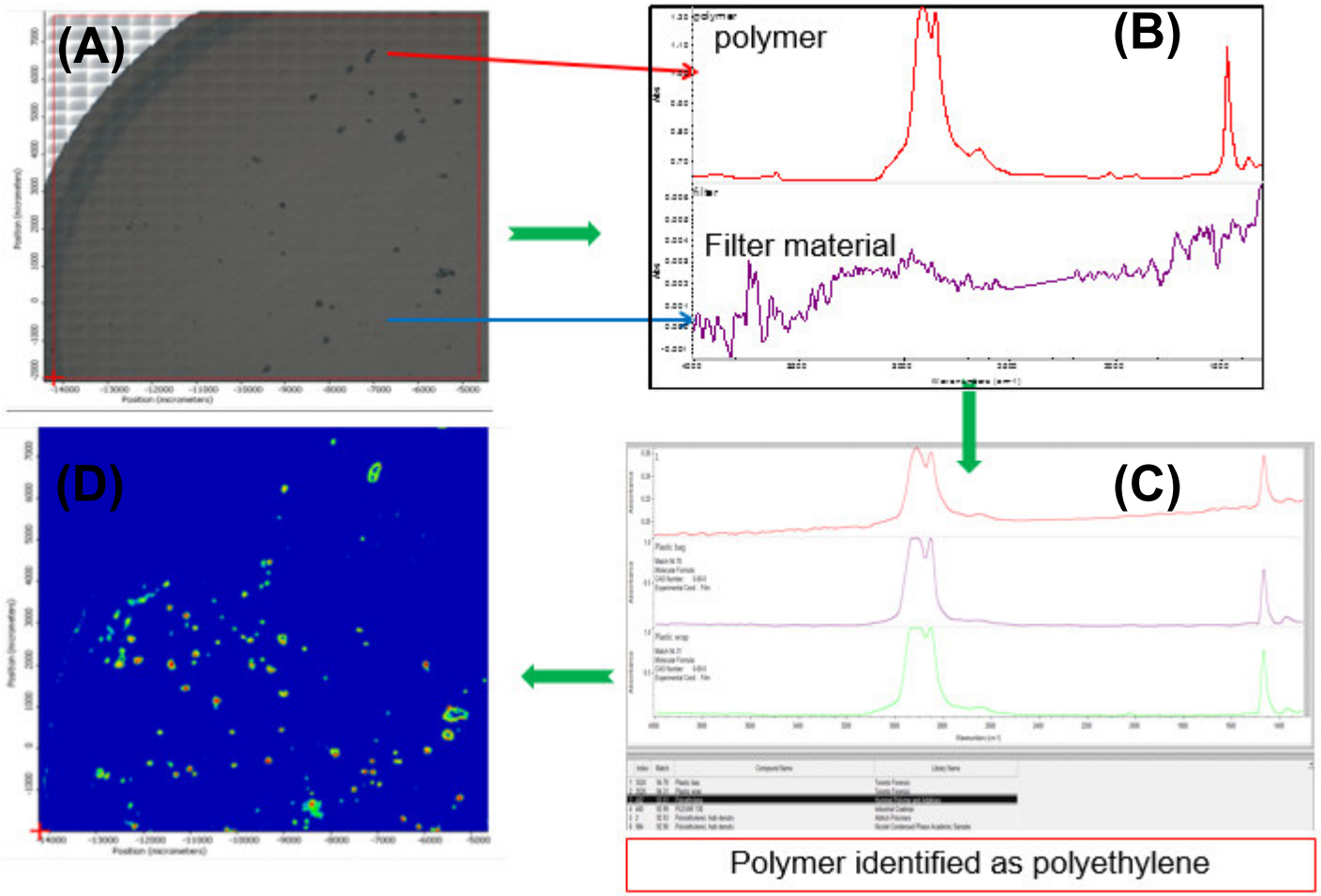
Example ➔ Micro FTIR for Microplastics analysis - **MEASURE and IDENTIFY**

(A)Visual image of the filter showing particles

(B)Spectra of one of the particles and the filter paper

(C)Library searching to identify the material of the particles

(D)Correlation map to localize the particles with the same chemistry



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Possible Approach ➔ Scan full filter

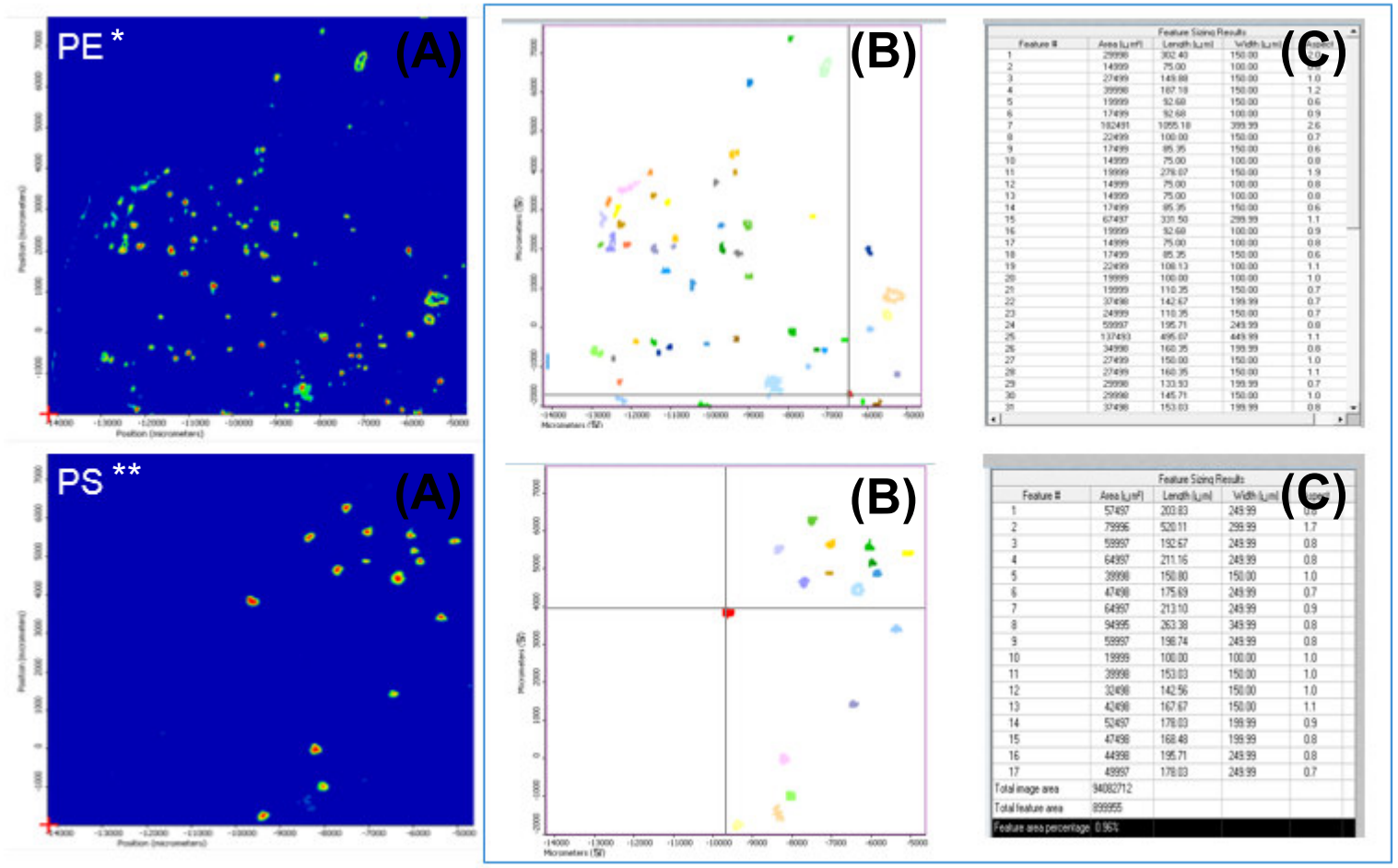
Analyzes with FTIR-Microscopy. Microplastic down to 10 micron

Example ➔ Micro FTIR for Microplastics analysis - **COUNT (Quantify)**

(A)Correlation maps

(B)Particle Analysis

(C)Number and size for the different chemistry



* Polyethilene
**Polystyrene

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Possible Approach ➔ Multiple maps in the particles region

Analyzes with Raman-Microscopy. Microplastics down to 1micron and additional information about inorganic fillers (*i.e.* carbonates, Titanium dioxide etc…)

Example ➔ Micro Raman for Microplastics analysis - **SAMPLING-TREATMENT-FILTRATION**

SAMPLING

Shoreline of Pellestrina beach (GPS: 45° 15' 58.507" N 12° 18' 7.639" E), one of the two long islands which border the **Venice Lagoon**

TREATMENT

Extraction performed by flotation 2 times on 250g of sediment employing a Sodium Iodide solution (1,8 g cm^{-3}), using an air flow (30 min) to shake sediments and help the particles to float.
Purification performed with Hydrogen (30%) peroxide to eliminate organic matter

FILTRATION

Filtration on an Aluminum Oxide 13mm filter (Anodisc, Whatman)

Possible Approach ➔ Multiple maps in the particles region

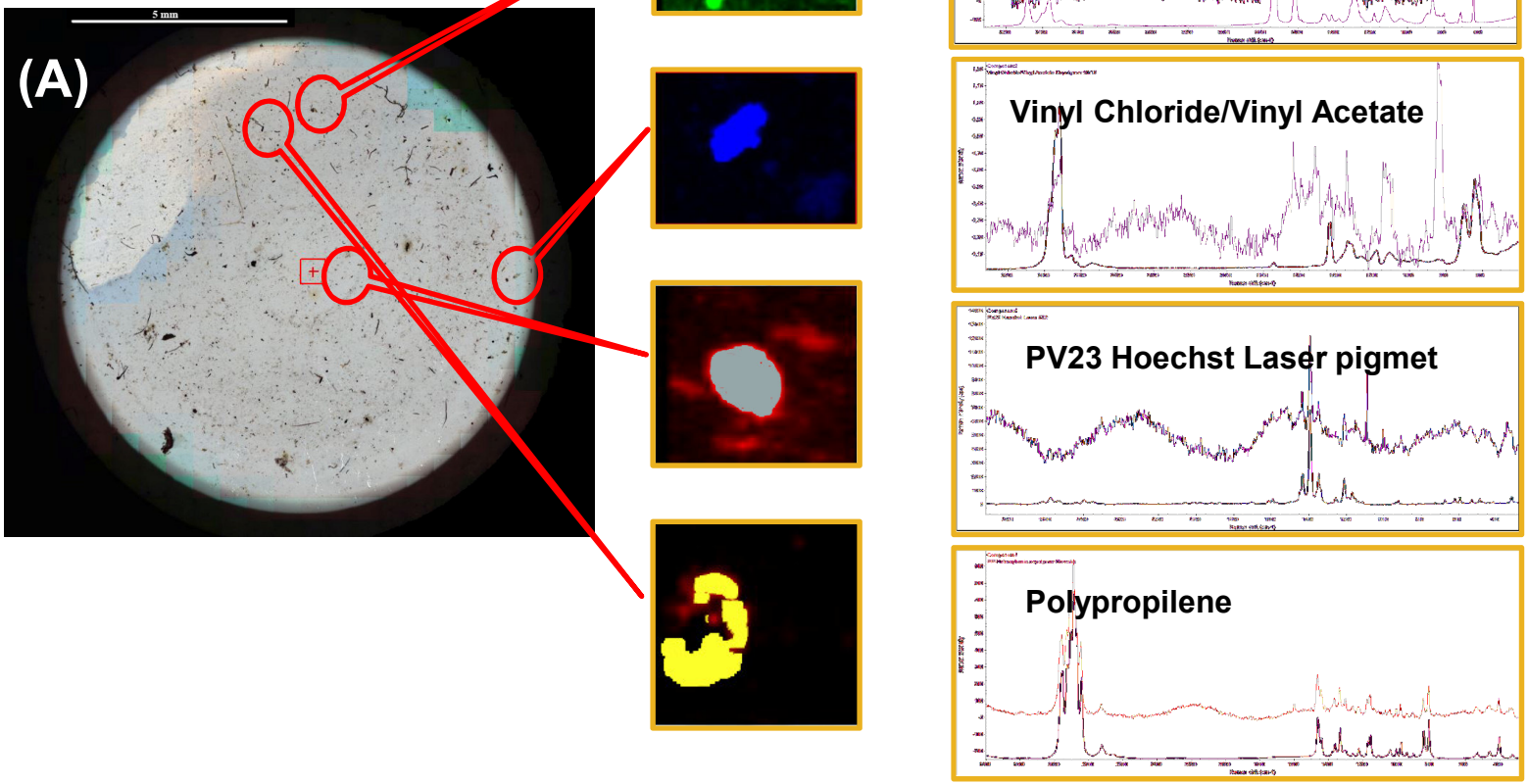
Analyzes with Raman-Microscopy. Microplastics down to 1micron and additional information about inorganic fillers (*i.e.* carbonates, Titanium dioxide etc…)

Example ➔ Micro Raman for Microplastics analysis - **MEASURE-IDENTIFY**

(A)Video image of the alumina filter showing particles

(B)Correlation maps

(C)Library searching to identify the material of the particles



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Best Approach & Benefit

If you need to analyze **stars**, are you analyzing the **full sky**? Or **just point the star**

If you need to analyze **particles**, are you analyzing the **full filter**? Or **just point the particles**

OUR VALUE PROPOSITION and BENEFITS:

AUTOMATIC ROUTINE ➔ Locate, Identify, quantify, understand length/width/Aspect-Ratio

Raman and/or FTIR ➔ We can provide both techniques according to your needs with the same analytical approach

FTIR down to 10 micron
RAMAN down to sub-micron

OPTIMIZE your analysis time

INCREASE your productivity and/or your publications

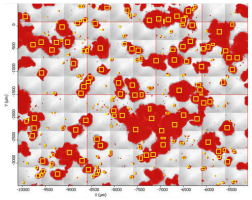
Best Approach ➔ Particle Wizard

Automatic routine to analyze particles on filters **available for Raman and Infrared Micorscopes**

Automated 4 steps process

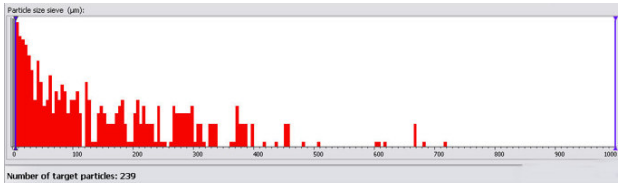
1. Locate

A Video Image allows to quickly locate and identify all the particles in the filter



2. Extract

The wizard extract from the video image the information of the particle sizes ➔ A Particle size sieve hystogram allows to select the sizes of interest to be analyzed



3. Identify

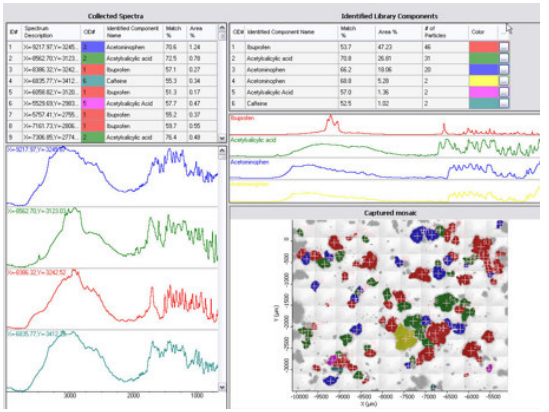
The wizard collect a spectrum (IR or Raman) for each particles and identify the chemistry by using libraries

Collected Spectra

ID#	Spectrum Description	CID#	Identified Component Name	Match %	Area %
1	X=-3300.89,Y=-4807.87	1	polyethylene	97.2	15.41
2	X=-888.05,Y=-4511.43	1	polyethylene	37.2	1.35
3	X=-503.49,Y=-4194.85		Unidentified	0.0	0.40
4	X=-1180.54,Y=-2923.71	1	polyethylene	42.7	0.67
5	X=-1401.11,Y=-3072.41	2	Polystyrene	90.2	7.40
6	X=-2860.71,Y=-2920.84	1	polyethylene	97.6	29.31
7	X=-1755.94,Y=-2877.66		Unidentified	0.0	11.17
8	X=-2550.95,Y=-2795.16	1	polyethylene	69.3	2.44
9	X=-3486.93,Y=-2583.15	1	polyethylene	45.1	0.22
10	X=-2495.33,Y=-2548.61	1	polyethylene	50.1	0.36
11	X=-2425.32,Y=-2673.32	1	polyethylene	84.5	0.79

4. Reporting

The wizard builds a report with the following information for each particle: Dimension (width, length, aspect-ratio); Number of particles; Chemistry (identification)



You analysis time is reduced from HOURS to MINUTES

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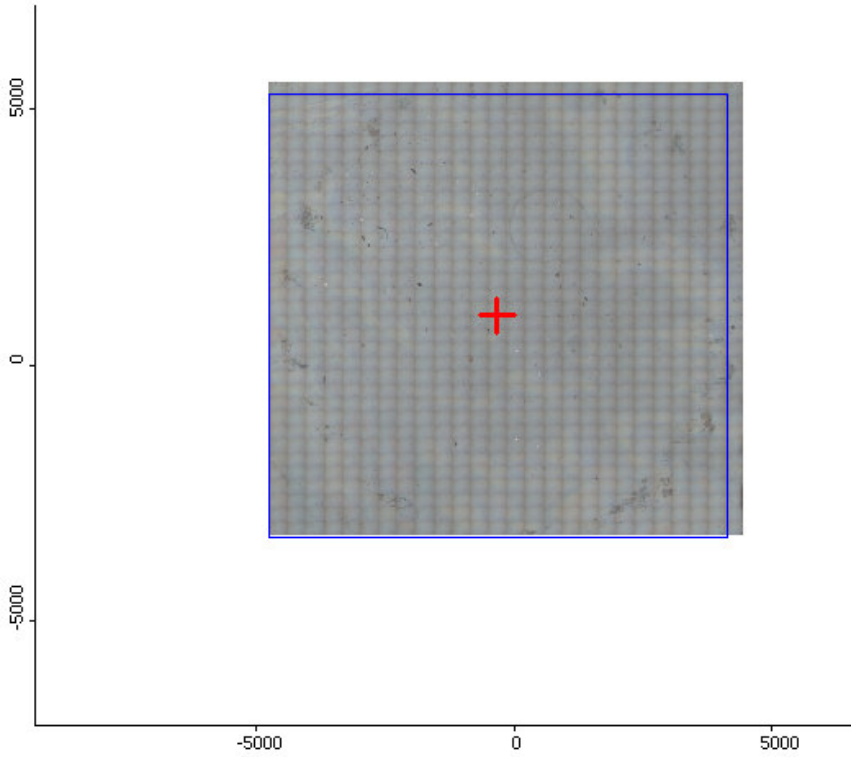
Particle wizard step by step

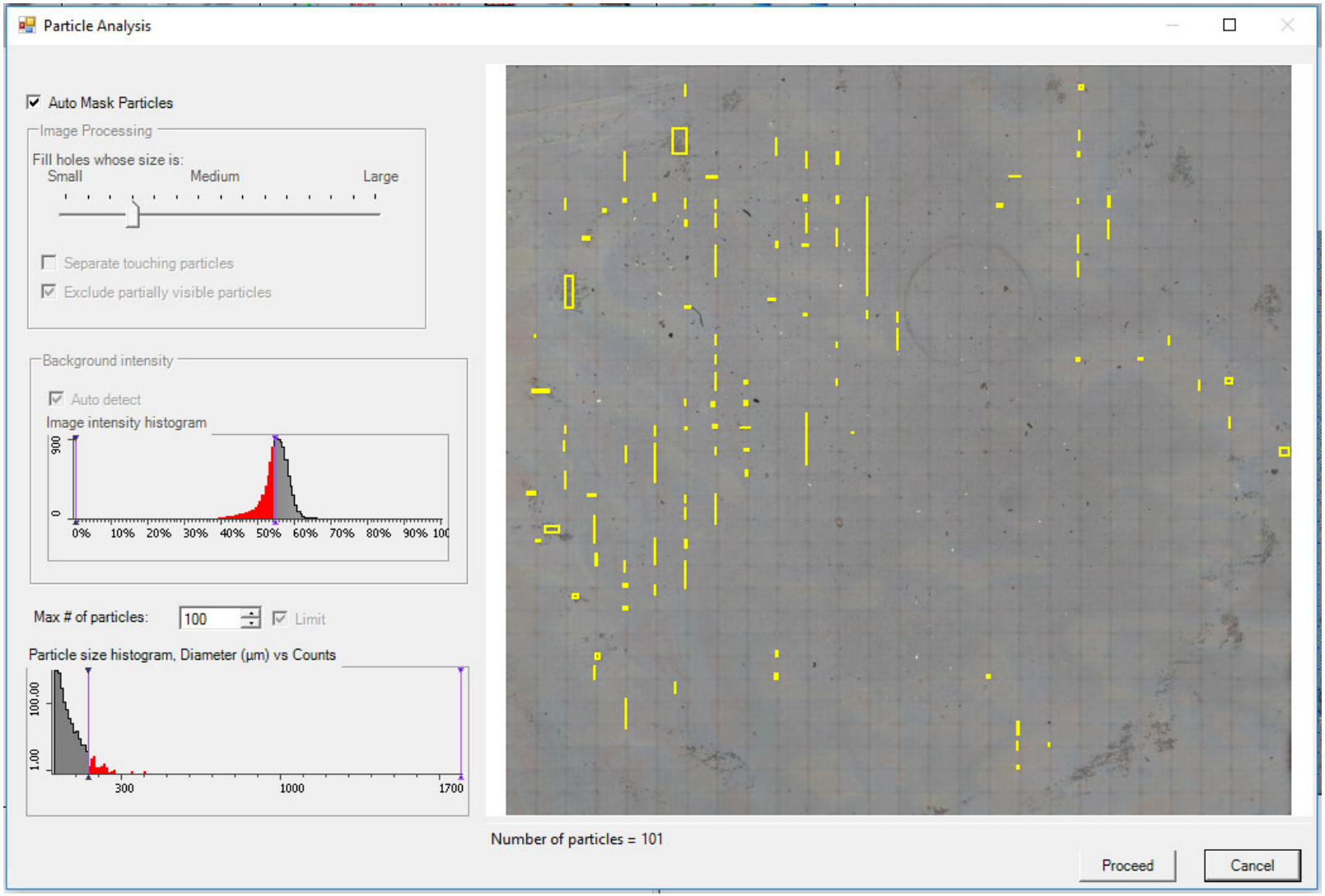
1st Step Collect a Mosaic



- Sample: Filtered bottled water 500 ml
- Silicon filter
- 8 mm diameter circular area (defined by gasket)
- 20X objective
- Visible Image (contrast) is important because visible image is used to select particles and determine size
- Raman is used for identification

Initial Automatic Settings

2nd Step Automatic particle selection



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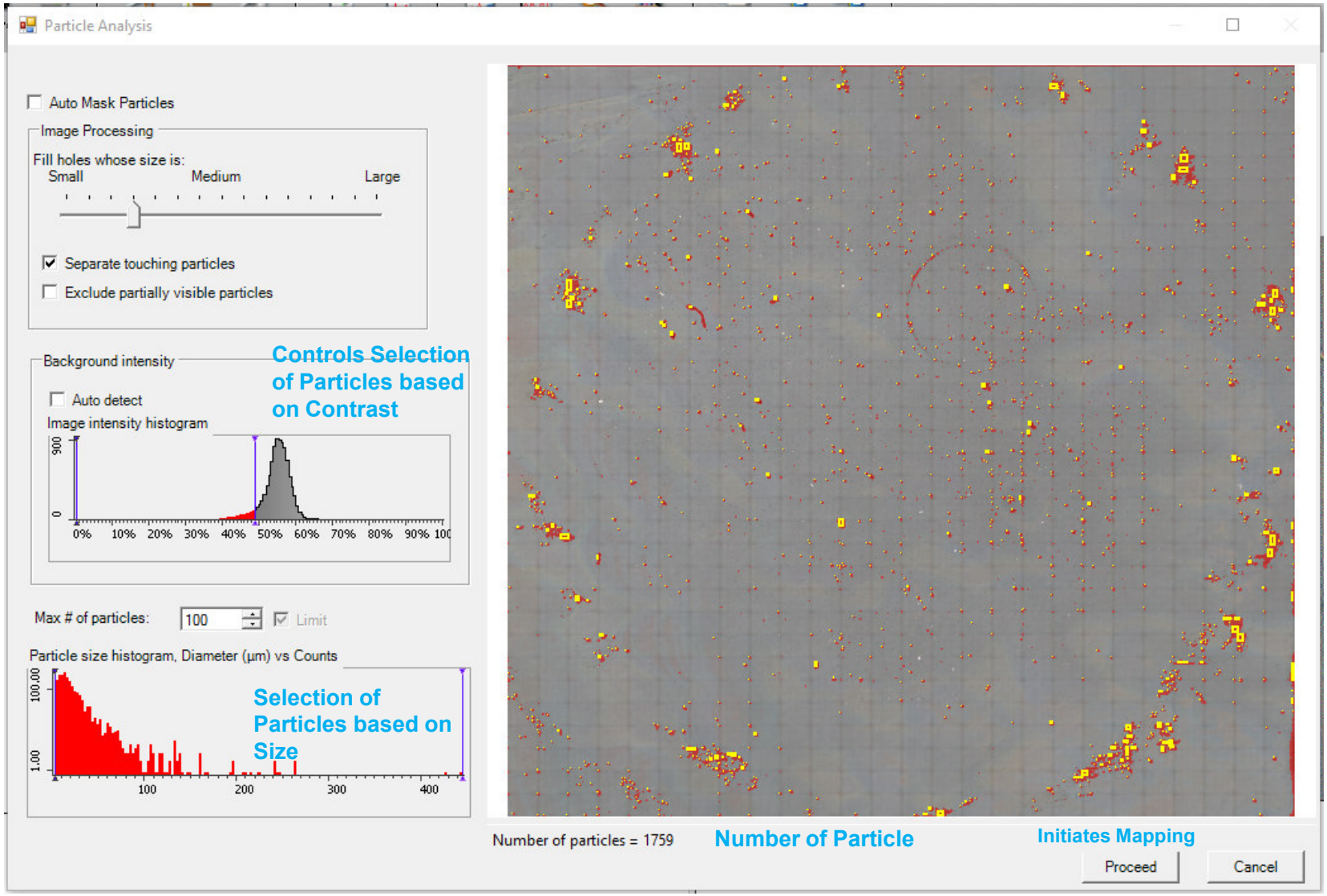
Adjusted Parameters

3rd Step optimization of particle selection



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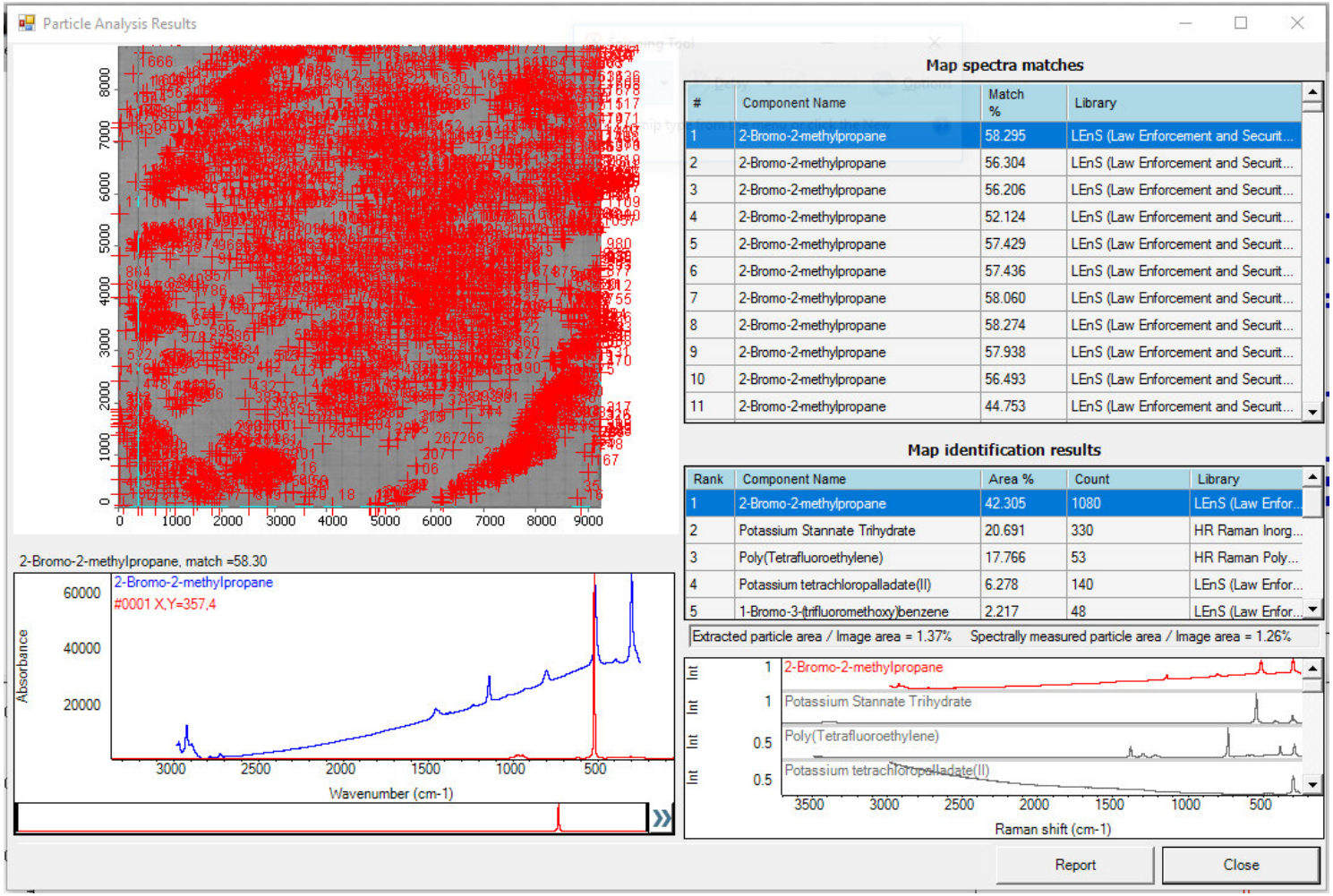
Analyze Particle Map

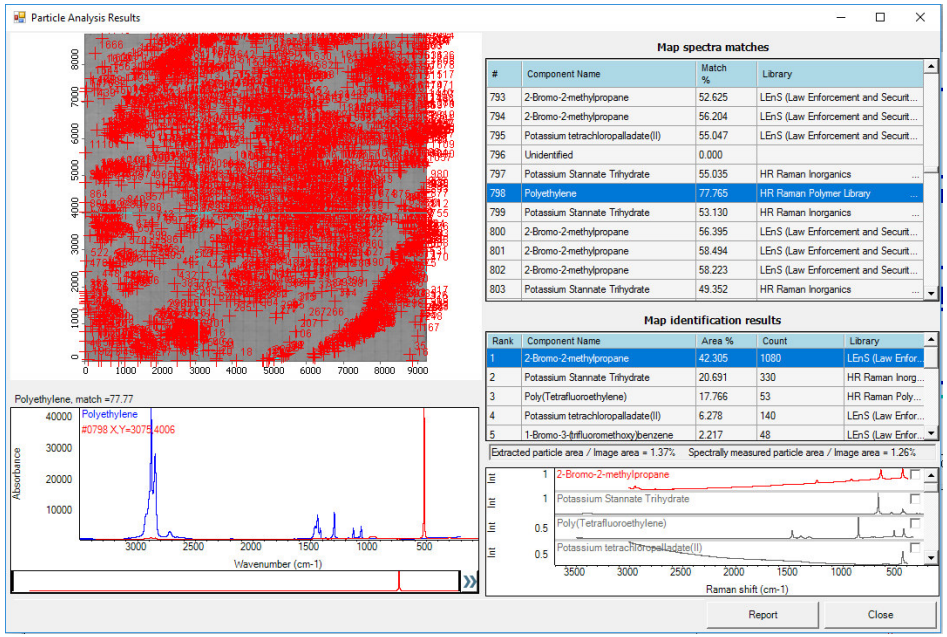


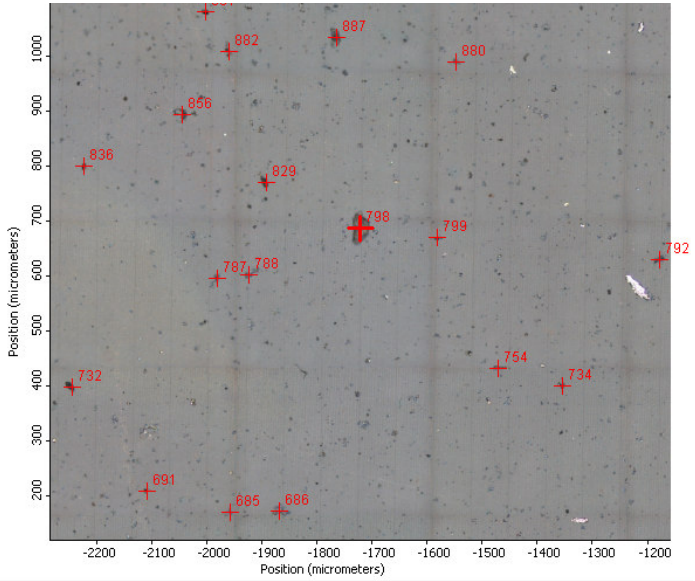
Select the right libraries

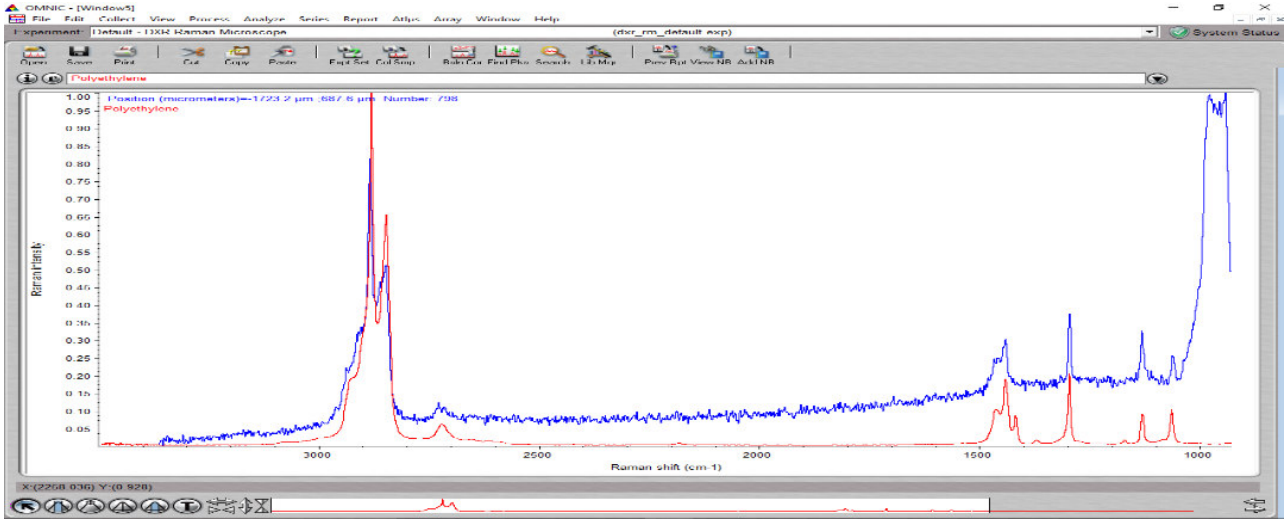
Dedicated library available upon request

Setup search regions to avoid some of the silicon peaks from the filter

Particle Example – Particle 798 - Polyethylene







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Print Report – Print to PDF – Individual Spectral Results

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Collected Spectra

#	Spectrum Position X,Y	Ran	Identified Component Name	Match	Area	Length	Width
1	#0001 X,Y=357,4	1	2-Bromo-2-methylpropane	58.3	62	13.9	5.7
2	#0002 X,Y=432,6	1	2-Bromo-2-methylpropane	56.3	62	11.1	7.1
3	#0003 X,Y=708,6	1	2-Bromo-2-methylpropane	56.21	116	16.7	8.9
4	#0004 X,Y=919,10	1	2-Bromo-2-methylpropane	52.12	279	25	14.2
5	#0005 X,Y=1071,6	1	2-Bromo-2-methylpropane	57.43	132	13.9	12
6	#0006 X,Y=1423,3	1	2-Bromo-2-methylpropane	57.44	15	5.6	3.5
7	#0007 X,Y=1787,8	1	2-Bromo-2-methylpropane	58.06	116	11.8	11.8
8	#0008 X,Y=2493,8	1	2-Bromo-2-methylpropane	58.27	371	30.6	15.5
9	#0009 X,Y=2852,6	1	2-Bromo-2-methylpropane	57.94	132	19.5	8.6
10	#0010 X,Y=3564,6	1	2-Bromo-2-methylpropane	56.49	147	16.7	11.2
11	#0011 X,Y=4800,7	1	2-Bromo-2-methylpropane	44.75	271	25	13.8
12	#0012 X,Y=4834,3	1	2-Bromo-2-methylpropane	49.79	15	5.6	3.5
13	#0013 X,Y=4927,4	2	Potassium Stannate Trihydrate	44.36	503	69.5	9.2
14	#0014 X,Y=4981,14	1	2-Bromo-2-methylpropane	52.83	116	16.7	8.9
15	#0015 X,Y=5109,28	1	2-Bromo-2-methylpropane	48.57	10244	198.6	65.7
16	#0016 X,Y=8861,7	4	Potassium tetrachloropalladate(II)	34.97	309	36.2	10.9
17	#0017 X,Y=1926,11	1	2-Bromo-2-methylpropane	50.88	46	8.3	7.1
18	#0018 X,Y=4097,19		Unidentified	0	487	30.6	20.3
19	#0019 X,Y=74,29	1	2-Bromo-2-methylpropane	53.6	101	11.1	11.1
20	#0020 X,Y=3549,60		Unidentified	0	727	36.2	25.6
21	#0021 X,Y=4917,56	1	2-Bromo-2-methylpropane	52.67	31	5.6	5.6
22	#0022 X,Y=4983,85		Unidentified	0	1470	52.9	35.4
23	#0023 X,Y=6224,74	4	Potassium tetrachloropalladate(II)	39.36	201	16.7	15.3
24	#0024 X,Y=1787,74	5	1-Bromo-3-(trifluoromethoxy)benzene	45.77	101	11.1	11.1
25	#0025 X,Y=1067,90	1	2-Bromo-2-methylpropane	48.82	271	19.5	17.7
26	#0026 X,Y=1502,97	2	Potassium Stannate Trihydrate	42.02	217	16.7	16.5
27	#0027 X,Y=5327,107	1	2-Bromo-2-methylpropane	44.66	116	13.9	10.6
28	#0028 X,Y=6174,114	1	2-Bromo-2-methylpropane	39.97	85	11.1	9.7
29	#0029 X,Y=5372,135	1	2-Bromo-2-methylpropane	46.68	162	16.7	12.4
30	#0030 X,Y=1883,145	1	2-Bromo-2-methylpropane	48.99	433	25	22
31	#0031 X,Y=5410,159	2	Potassium Stannate Trihydrate	35.93	1486	51.3	36.9

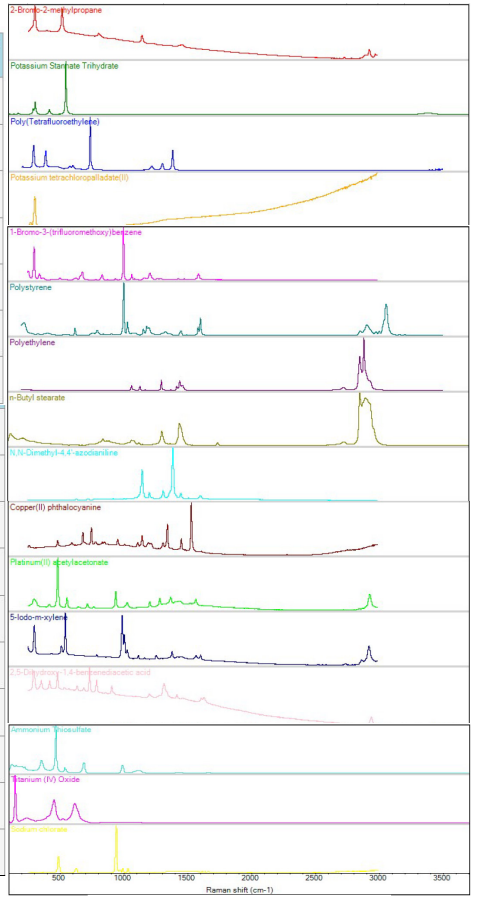
1742	#1742 X,Y=1788,8698	2	Potassium Stannate Trihydrate	50.8	124	13.9	11.3
1743	#1743 X,Y=462,8712	2	Potassium Stannate Trihydrate	41.52	898	47.3	24.2
1744	#1744 X,Y=4641,8712	2	Potassium Stannate Trihydrate	51.93	1207	67.7	22.7
1745	#1745 X,Y=6454,8713	1	2-Bromo-2-methylpropane	60.06	201	20.1	12.8
1746	#1746 X,Y=4905,8715	2	Potassium Stannate Trihydrate	57.04	70	8.3	8.3
1747	#1747 X,Y=8577,8730		Unidentified	0	781	38.9	25.6
1748	#1748 X,Y=2977,8726	2	Potassium Stannate Trihydrate	51.72	101	11.1	11.1
1749	#1749 X,Y=8982,8740	2	Potassium Stannate Trihydrate	45.36	317	22.4	18
1750	#1750 X,Y=9167,8733	1	2-Bromo-2-methylpropane	54.78	31	5.6	5.6
1751	#1751 X,Y=9246,8741	2	Potassium Stannate Trihydrate	46.35	286	22.3	16.4
1752	#1752 X,Y=3954,8780	2	Potassium Stannate Trihydrate	50.07	1238	69.5	22.7
1753	#1753 X,Y=4574,8763	1	2-Bromo-2-methylpropane	53.93	487	27.8	22.3
1754	#1754 X,Y=4632,8758	5	1-Bromo-3-(trifluoromethoxy)benzene	54.62	170	19.5	11.1
1755	#1755 X,Y=3931,8780	1	2-Bromo-2-methylpropane	52.5	232	27.8	10.6
1756	#1756 X,Y=9035,8780		Unidentified	0	743	38.9	24.3
1757	#1757 X,Y=4646,8795	1	2-Bromo-2-methylpropane	47.77	371	27.8	17
1758	#1758 X,Y=3931,8811	2	Potassium Stannate Trihydrate	42.37	108	13.9	9.9
1759	#1759 X,Y=4671,8809	2	Potassium Stannate Trihydrate	57.36	93	13.9	8.5

Spectra 1 to 1759 (47 pages)

Print Report – Print to PDF – Library Components & Spectra

Identified Library Components

Ran	Identified Component Name	Component Library Name	Match	Area	# of	Colo
1	2-Bromo-2-methylpropane	LEnS (Law Enforcement and Security) Raman Library	53.83	42.31	1080	
2	Potassium Stannate Trihydrate	HR Raman Inorganics	49.28	20.69	330	
3	Poly(Tetrafluoroethylene)	HR Raman Polymer Library	47.21	17.77	53	
4	Potassium tetrachloropalladate(II)	LEnS (Law Enforcement and Security) Raman Library	50.08	6.28	140	
5	1-Bromo-3-(trifluoromethoxy)benzene	LEnS (Law Enforcement and Security) Raman Library	54.15	2.22	48	
6	Polystyrene	HR Raman Polymer Library	78.64	0.81	1	
7	Polyethylene	HR Raman Polymer Library	85.48	0.38	2	
8	n-Butyl stearate	HR FT-Raman Polymer Library Addendum 1	63.67	0.37	1	
9	N,N-Dimethyl-4,4'-azodianiline	LEnS (Law Enforcement and Security) Raman Library	69.27	0.08	1	
10	Copper(II) phthalocyanine	LEnS (Law Enforcement and Security) Raman Library	42.32	0.08	1	
11	Platinum(II) acetylacetonate	LEnS (Law Enforcement and Security) Raman Library	54.59	0.03	2	
12	5-Iodo-m-xylene	LEnS (Law Enforcement and Security) Raman Library	30.57	0.03	1	
13	2,5-Dihydroxy-1,4-benzenediacetic acid	LEnS (Law Enforcement and Security) Raman Library	40.57	0.03	1	
14	Ammonium Thiosulfate	HR Raman Inorganics	39.05	0.01	1	
15	Titanium (IV) Oxide	HR Raman Inorganics	61.19	0.01	1	
16	Sodium chlorate	LEnS (Law Enforcement and Security) Raman Library	30.73	0.01	1	
999	Unidentified	Unidentified		8.91	95	

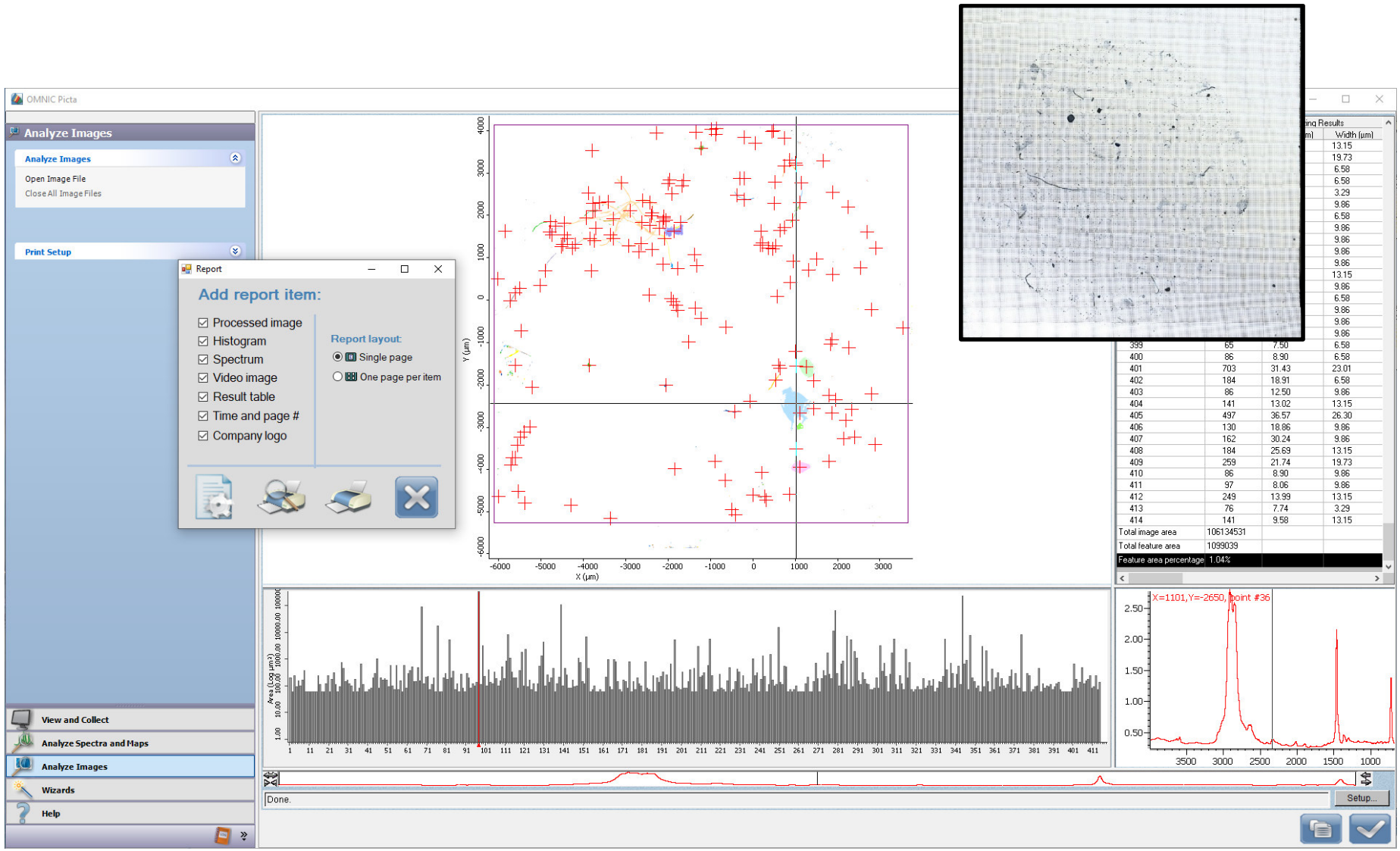


ThermoFisher SCIENTIFIC

Particle Wizard ➔ Bottled water - Micro FTIR

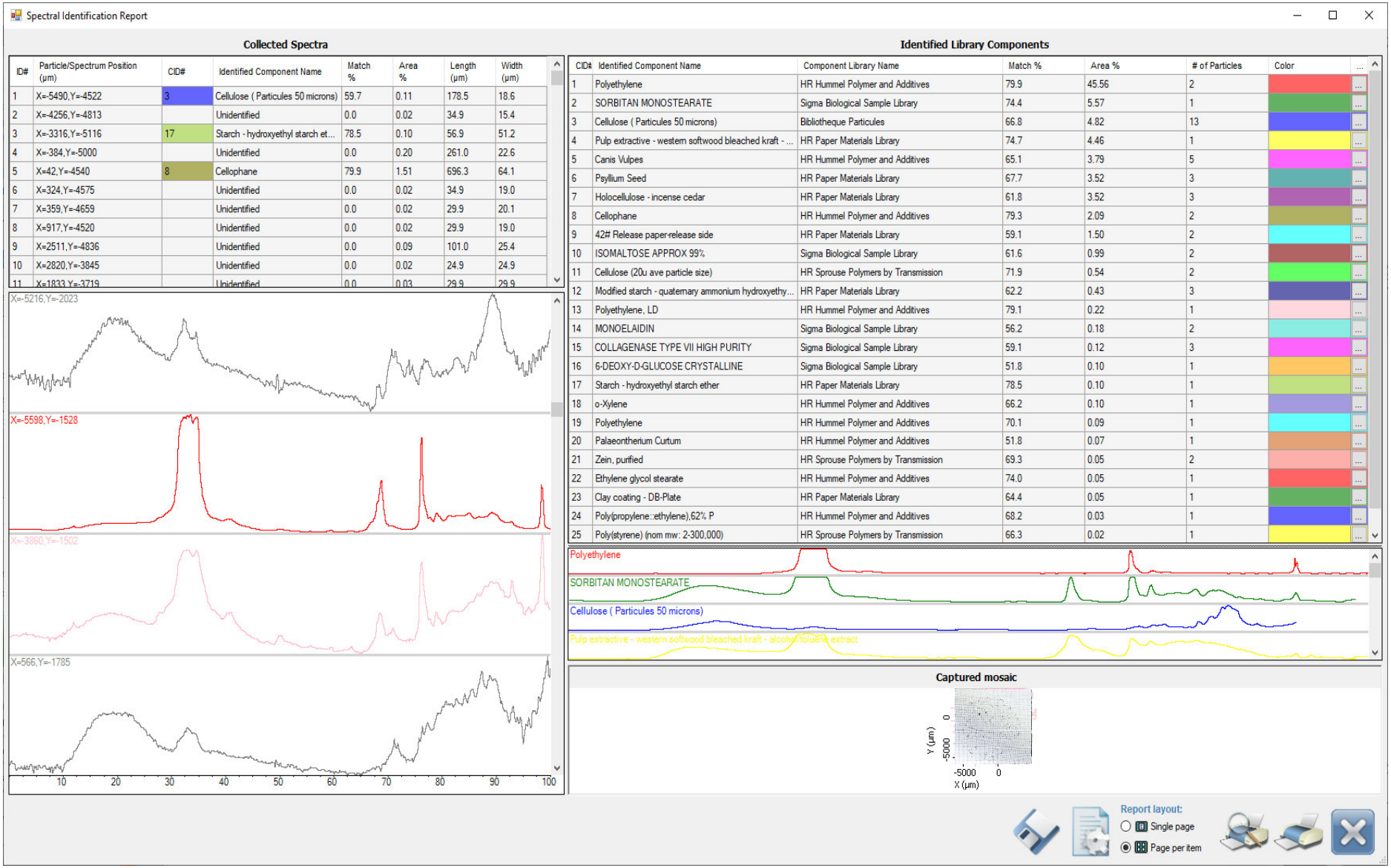
6 bottles (500ml) of still water filtered

Particle Wizard ➔ Bottled water - Micro FTIR



ThermoFisher SCIENTIFIC

Particle Wizard ➔ Bottled water - Micro FTIR



Collected Spectra

ID#	Particle/Spectrum Position (µm)	CID#	Identified Component Name	Match %	Area %	Length (µm)	Width (µm)
1	X=-5490,Y=-4522	3	Cellulose (Particules 50 microns)	59.7	0.11	178.5	18.6
2	X=-4256,Y=-4813		Unidentified	0.0	0.02	34.9	15.4
3	X=-3316,Y=-5116	17	Starch - hydroxyethyl starch et...	78.5	0.10	56.9	51.2
4	X=-384,Y=-5000		Unidentified	0.0	0.20	261.0	22.6
5	X=42,Y=-4540	8	Cellophane	79.9	1.51	696.3	64.1
6	X=324,Y=-4575		Unidentified	0.0	0.02	34.9	19.0
7	X=359,Y=-4659		Unidentified	0.0	0.02	29.9	20.1
8	X=917,Y=-4520		Unidentified	0.0	0.02	29.9	19.0
9	X=2511,Y=-4836		Unidentified	0.0	0.09	101.0	25.4
10	X=2820,Y=-3845		Unidentified	0.0	0.02	24.9	24.9
11	X=1833,Y=-3719		Unidentified	0.0	0.03	29.9	29.9

Identified Library Components

CID#	Identified Component Name	Component Library Name	Match %	Area %	# of Particles	Color
1	Polyethylene	HR Hummel Polymer and Additives	79.9	45.56	2	
2	SORBITAN MONOSTEARATE	Sigma Biological Sample Library	74.4	5.57	1	
3	Cellulose (Particules 50 microns)	Bibliotheque Particules	66.8	4.82	13	
4	Pulp extractive - western softwood bleached kraft - ...	HR Paper Materials Library	74.7	4.46	1	
5	Canis Vulpes	HR Hummel Polymer and Additives	65.1	3.79	5	
6	Psyllium Seed	HR Paper Materials Library	67.7	3.52	3	
7	Holocellulose - incense cedar	HR Paper Materials Library	61.8	3.52	3	
8	Cellophane	HR Hummel Polymer and Additives	79.3	2.09	2	
9	42# Release paper-release side	HR Paper Materials Library	59.1	1.50	2	
10	ISOMALTOSE APPROX 99%	Sigma Biological Sample Library	61.6	0.99	2	
11	Cellulose (20u ave particle size)	HR Sprouse Polymers by Transmission	71.9	0.54	2	
12	Modified starch - quaternary ammonium hydroxyethy...	HR Paper Materials Library	62.2	0.43	3	
13	Polyethylene, LD	HR Hummel Polymer and Additives	79.1	0.22	1	
14	MONOELAIDIN	Sigma Biological Sample Library	56.2	0.18	2	
15	COLLAGENASE TYPE VII HIGH PURITY	Sigma Biological Sample Library	59.1	0.12	3	
16	6-DEOXY-D-GLUCOSE CRYSTALLINE	Sigma Biological Sample Library	51.8	0.10	1	
17	Starch - hydroxyethyl starch ether	HR Paper Materials Library	78.5	0.10	1	
18	o-Xylene	HR Hummel Polymer and Additives	66.2	0.10	1	
19	Polyethylene	HR Hummel Polymer and Additives	70.1	0.09	1	
20	Palaeontherium Curtum	HR Hummel Polymer and Additives	51.8	0.07	1	
21	Zein, purified	HR Sprouse Polymers by Transmission	69.3	0.05	2	
22	Ethylene glycol stearate	HR Hummel Polymer and Additives	74.0	0.05	1	
23	Clay coating - DB-Plate	HR Paper Materials Library	64.4	0.05	1	
24	Poly(propylene::ethylene),62% P	HR Hummel Polymer and Additives	68.2	0.03	1	
25	Poly(styrene) (nom mw: 2-300,000)	HR Sprouse Polymers by Transmission	66.3	0.02	1	

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