The Invisible Ingredient: Confronting the Microplastics Risk

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eurofins
Testing for Life

Acknowledgments

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Eurofins key figures

65,000+
employees

450,000,000+
tests performed each year

200,000+
validated analytical methods

ca. 950+
laboratories

+62
active countries

Our history

Eurofins derived the "fins" of its name from the French version of SNIF-NMR: ***Fractionnement Isotopique Naturel Spécifique*** par Résonance Magnétique Nucléaire or FINS-RMN. During this start-up period (1987 to 1997), the SNIF-NMR patent was registered.

Start

1987

Eurofins CEO Dr. Gilles Martin established Eurofins in 1987 with 3 employees in Nantes, France offering food testing analyses.

1997-2001

We began to expand rapidly around the world, joining forces with the best laboratories to build a leading position in food and environment testing markets. Eurofins Scientific lists on the Paris Stock Exchange in 1997. By 2001, Eurofins was present in 8 countries, with a network of over 50 laboratories.

2002-2004

Eurofins developed bigger and more productive sites, establishing the infrastructure we needed to support our growth in Europe.

2005-2008

Eurofins then turned its attention to **new geographies and markets**, including China, Sweden, Norway and Ireland, growing to 8,000 staff and more that 150 laboratories in 29 countries.

Our history

2009-2011

Despite worldwide economic austerity, **our organic growth remained positive in 2009.** By 2011, we were present in 30 countries, with 10,000 staff in 150 laboratories. Eurofins increased focus on growth in North America.

2012-2015

AUS operations start

In 2012, 15 years after our IPO, **the Eurofins network became a one-billion-euro annual revenue business.** We achieved market leadership positions in discovery pharmacology, genomics testing, and food testing. In 2013, Eurofins became the second largest food testing service provider in the U.S.A.

2015-2022

By 2012, Eurofins companies employed 22,000 staff in more that 225 laboratories, which grew to 50,000 employees and 800 laboratories in 50 countries by 2020. We surpassed €5 billion in revenues in 2020 and became a global leader in food, environment and pharmaceutical product testing.

In 2020, Eurofins companies created capacity to help over 20 million patients monthly, who may have been impacted by COVID-19, with our testing products and services, established widespread PCR testing capabilities, supported the development of a number of vaccines and established our SAFER@WORK™ programme.

2025 onwards

Having established best-in-class laboratory infrastructure in Europe and North America, we're looking to the future, to expansion of our network in these regions, as well as in Asia and Latin America, and investing in innovation and digitalisation. **We're continuing to set standards in service and innovation in Testing for Life.**

Microplastics Peer Group's Global network

Norway

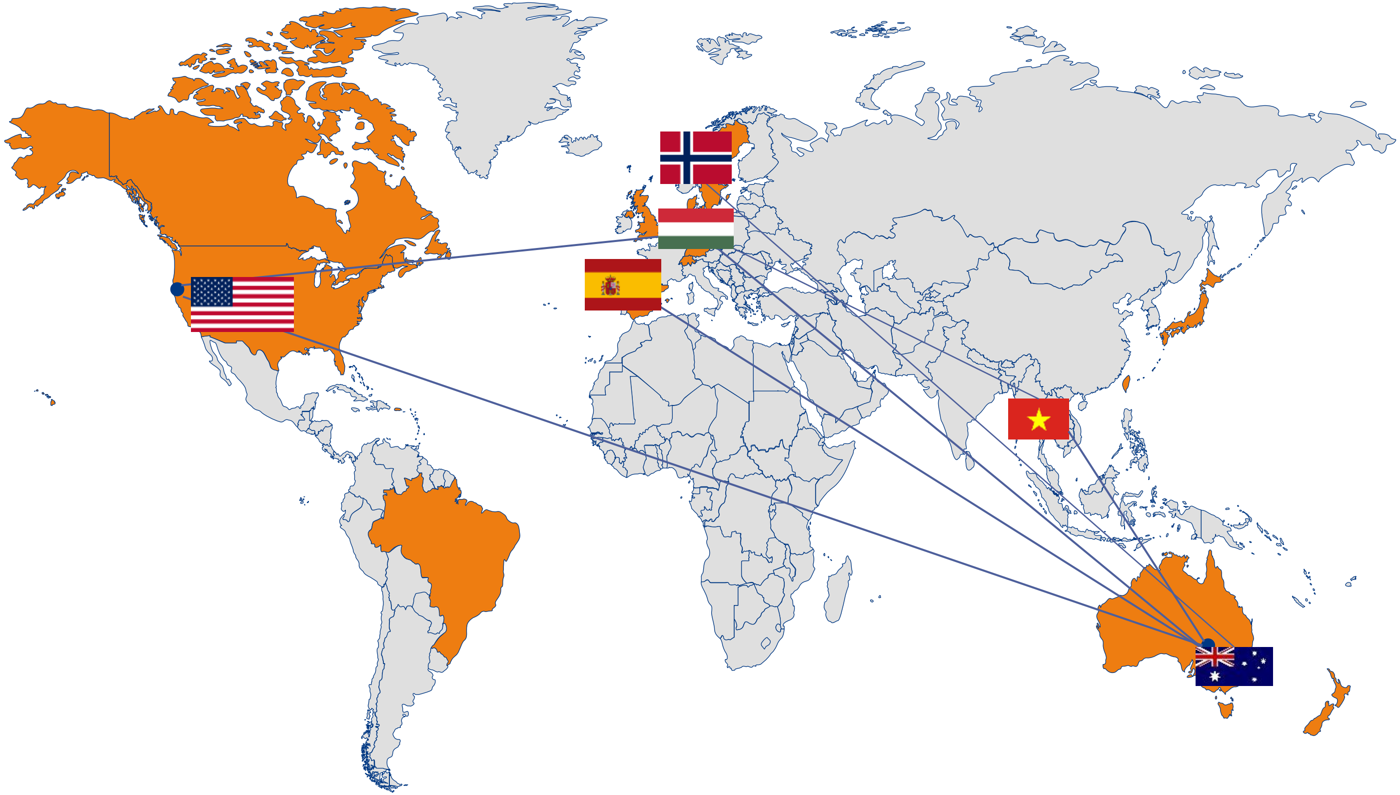
Spain

Hungary

USA

Australia

Vietnam



How plastics are made

How plastics are made

- Plastics are derived from natural, organic materials such as cellulose, coal, natural gas, salt and, of course, crude oil.
- Crude oil is a complex mixture of thousands of compounds and needs to be processed before it can be used.
- The production of plastics begins with the distillation of crude oil in an oil refinery. This separates the heavy crude oil into groups of lighter components, called fractions. Each fraction is a mixture of hydrocarbon chains (chemical compounds made up of carbon and hydrogen), which differ in terms of the size and structure of their molecules.
- One of these fractions, naphtha, is the crucial compound for the production of plastics.

Two main polymer families

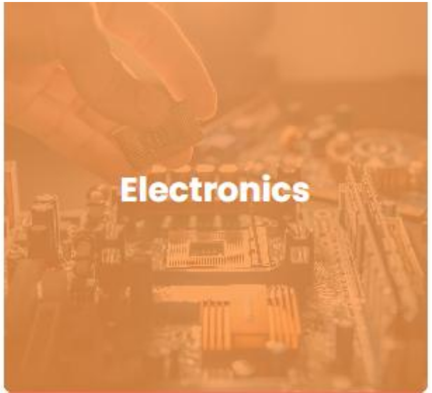
Examples of Thermoplastics	**Examples of Thermosets**
Acrylonitrile butadiene styrene (ABS) Polycarbonate (PC) Polyethylene (PE) Polyethylene terephthalate (PET) Polytetrafluoroethylene (PTFE) Polyvinyl chloride (PVC) Polymethyl methacrylate (PMMA) Polypropylene (PP) Polystyrene (PS) Expanded Polystyrene (EPS)	Epoxide (EP) Phenol-formaldehyde (PF) Polyurethane (PUR) Unsaturated polyester resins (UP)

How are plastics used?


Packaging


Healthcare


Mobility & Transport


Electronics

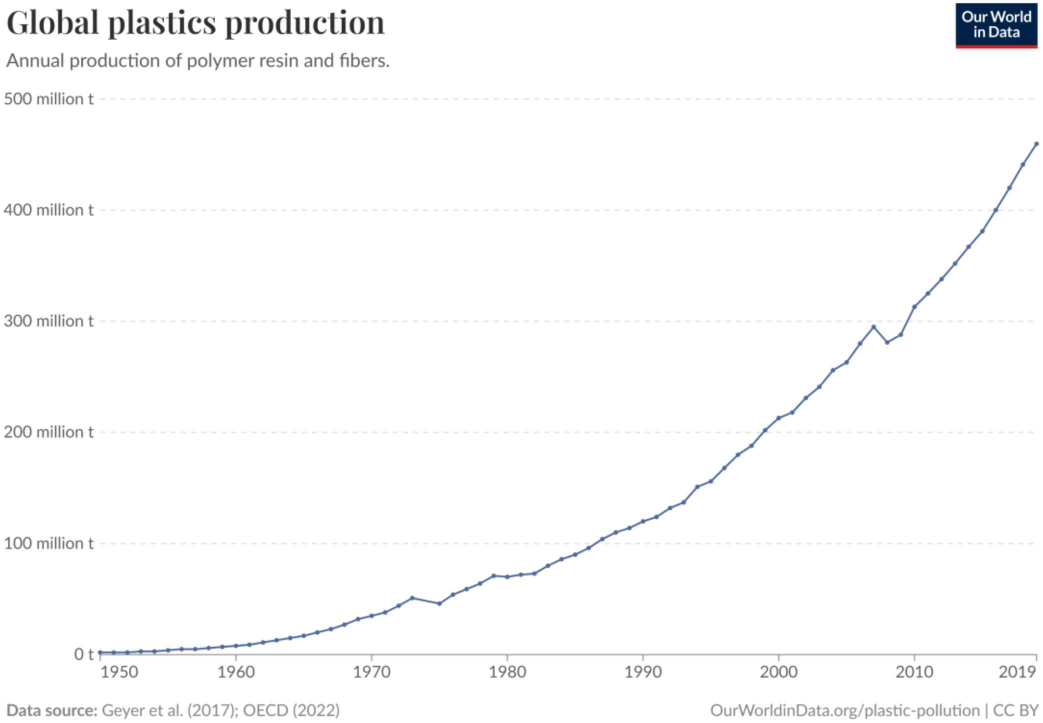

Agriculture


Sport & Leisure equipment

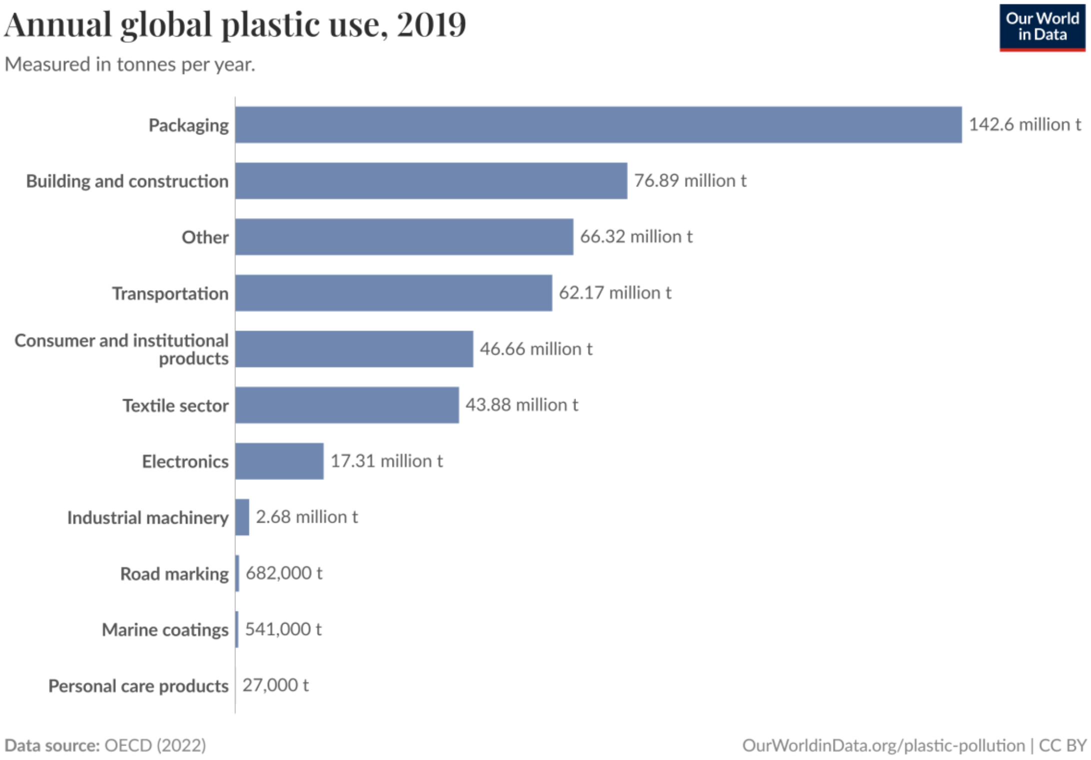

Building & Construction


Energy

Plastics production



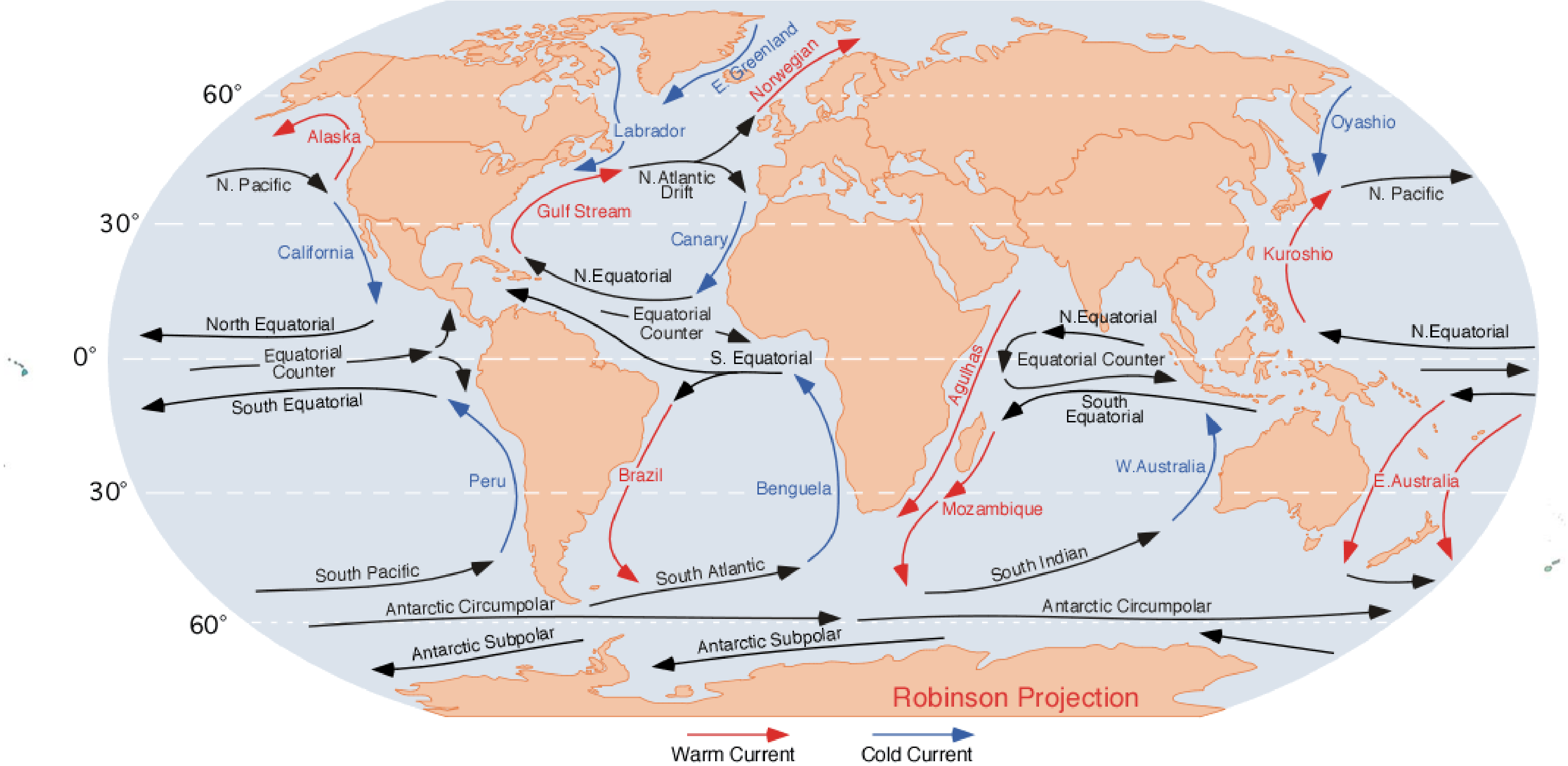
Global use



Data source: OECD (2022)

OurWorldinData.org/plastic-pollution | CC BY

Share of plastics waste emitted to the ocean, 2019



Data source: Meijer et al. (2021)
OurWorldinData.org/plastic-pollution

Scientists reviewed 7,000 studies on microplastics

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AUSTRALIA

Scientists reviewed 7,000 studies on microplastics

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Science

Twenty years after the first publication that used the term microplastic, we review current understanding, refine definitions, and consider future prospects. Microplastics arise from multiple sources, including tyres, textiles, cosmetics, paint, and the fragmentation of larger items. They are widely distributed throughout the natural environment, with evidence of harm at multiple levels of biological organisation. They are pervasive in food and drink and have been detected throughout the human body, with emerging evidence of negative effects. Environmental contamination could double by 2040, and wide-scale harm has been predicted. Public concern is increasing, and diverse measures to address microplastic pollution are being considered in international negotiations. Clear evidence on the efficacy of potential solutions is now needed to address the issue and to minimise the risks of unintended consequences.

BREVIA

Lost at Sea: Where Is All the Plastic?

Richard C. Thompson,[1]* Ylva Olsen,[1] Richard P. Mitchell,[1] Anthony Davis,[1] Steven J. Rowland,[1] Anthony W. G. John,[2] Daniel McGonigle,[3] Andrea E. Russell[3]

Millions of metric tons of plastic are produced annually. Countless large items of plastic debris are accumulating in marine habitats worldwide and may persist for centuries (*1–4*). Here we show that microscopic plastic fragments and fibers (Fig. 1A) are also widespread in the oceans and have accumulated in the pelagic zone and sedimentary habitats. The fragments appear to have resulted from degradation of larger items. Plastics of this size are ingested by marine organisms, but the environmental consequences of this contamination are still unknown.

Over the past 40 years, large items of plastic debris have frequently been recorded in habitats from the poles to the equator (*1–4*). Smaller fragments, probably also plastic, have been reported (*5*) but have received far less attention. Most plastics are resistant to biodegradation, but will break down gradually through mechanical action (*6*). Many "biodegradable" plastics are composites with materials such as starch that biodegrade, leaving behind numerous, nondegradable, plastic fragments (*6*). Some cleaning agents also contain abrasive plastic fragments (*2*). Hence, there is considerable potential for large-scale accumulation of microscopic plastic debris.

To quantify the abundance of microplastics, we collected sediment from beaches and from estuarine and subtidal sediments around Plymouth, UK (Fig. 1B). Less dense particles were separated by flotation. Those that differed in appearance to natural particulate material (Fig. 1A) were removed and identified with Fourier Transform infrared (FT-IR) spectroscopy (*7*). Some were of natural origin and others could not be identified, but about one third were synthetic polymers (Fig. 1C). These polymers were present in most samples (23 out of 30), but were significantly more abundant in subtidal sediment (Fig. 1D). Nine polymers were conclusively identified: acrylic, alkyd, poly (ethylene:propylene), polyamide (nylon), polyester, polyethylene, polymethylacrylate, polypropylene, and polyvinyl-alcohol. These have a wide range of uses, including clothing, packaging, and rope, suggesting that the fragments resulted from the breakdown of larger items.

To assess the extent of contamination, a further 17 beaches were examined (Fig. 1B). Similar fibers were found, demonstrating that microscopic plastics are common in sedimentary habitats. To assess long-term trends in abundance, we examined plankton samples collected regularly since the 1960s along routes between Aberdeen and the Shetlands (315 km) and from Sule Skerry to Iceland (850 km) (*7*) (Fig. 1B). We found plastic archived among the plankton in samples back to the 1960s, but with a significant increase in abundance over time (Fig. 1E). We found similar types of polymer in the water column as in sediments, suggesting that polymer density was not a major factor influencing distribution.

It was only possible to quantify fragments that differed in appearance from sediment grains or plankton. Some fragments were granular, but most were fibrous, ~20 µm in diameter, and brightly colored. We believe that these probably represent only a small proportion of the microscopic plastic in the environment, and methods are now needed to quantify the full spectrum of material present. The consequences of this contamination are yet to be established. Large plastic items can cause suffocation and entanglement and disrupt digestion in birds, fish, and mammals (*3*). To determine the potential for microscopic plastics to be ingested, we kept amphipods (detritivores), lugworms (deposit feeders), and barnacles (filter feeders) in aquaria with small quantities of microscopic plastics. All three species ingested plastics within a few days (*7*) (fig. S1).

Our findings demonstrate the broad spatial extent and accumulation of this type of contamination. Given the rapid increase in plastic production (Fig. 1E), the longevity of plastic, and the disposable nature of plastic items (*2*, *3*), this contamination is likely to increase. There is the potential for plastics to adsorb, release, and transport chemicals (*3*, *4*). However, it remains to be shown whether toxic substances can pass from plastics to the food chain. More work is needed to establish whether there are any environmental consequences of this debris.

Fig. 1. (**A**) One of numerous fragments found among marine sediments and identified as plastic by FT-IR spectroscopy. (**B**) Sampling locations in the northeast Atlantic. Six sites near Plymouth (□) were used to compare the abundance of microplastic among habitats. Similar fragments (●) were found on other shores. Routes sampled by Continuous Plankton Recorder (CPR 1 and 2) were used to assess changes in microplastic abundance since 1960. (**C**) FT-IR spectra of a microscopic fragment matched that of nylon. (**D**) Microplastics were more abundant in subtidal habitats than on sandy beaches (*, $F_{2,3} = 13.26$, $P < 0.05$), but abundance was consistent among sites within habitat types. (**E**) Microscopic plastic in CPR samples revealed a significant increase in abundance when samples from the 1960s and 1970s were compared to those from the 1980s and 1990s (*, $F_{3,3} = 14.42$, $P < 0.05$). Approximate global production of synthetic fibers is overlain for comparison. Microplastics were also less abundant along oceanic route CPR 1 than along CPR 2 ($F_{1,24} = 5.18$, $P < 0.05$).

References and Notes

1. P. G. Ryan, C. L. Moloney, *Nature* **361**, 23 (1993).
2. M. R. Gregory, P. G. Ryan, in *Marine Debris*, J. M. Coe, D. B. Rogers, Eds. (Springer, Berlin, 1996), pp. 48–70.
3. J. G. B. Derraik, *Mar. Pollut. Bull.* **44**, 842 (2002).
4. E. J. Carpenter, S. J. Anderson, G. R. Harvey, H. P. Miklas, B. P. Bradford, *Science* **178**, 749 (1972).
5. J. B. Colton, F. D. Knapp, B. R. Burns, *Science* **185**, 491 (1974).
6. P. P. Klemchuck, *Polym. Degrad. Stab.* **27**, 183 (1990).
7. Materials and methods are available as supporting material online on *Science* Online.
8. We thank C. Hoare, R. Ticehurst, G. Mandair, and F. Birembaut for help with sample collection and analysis. Supported by the Leverhulme Trust, UK.

Supporting Online Material
www.sciencemag.org/cgi/content/full/304/5672/838/DC1
Materials and Methods
Fig. S1
References and Notes

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Myths, overstatements

ELSEVIER

Journal of Hazardous Materials Letters

Volume 3, November 2022, 100071

Ingested microplastics: Do humans eat one credit card per week?

Martin Pletz ✉

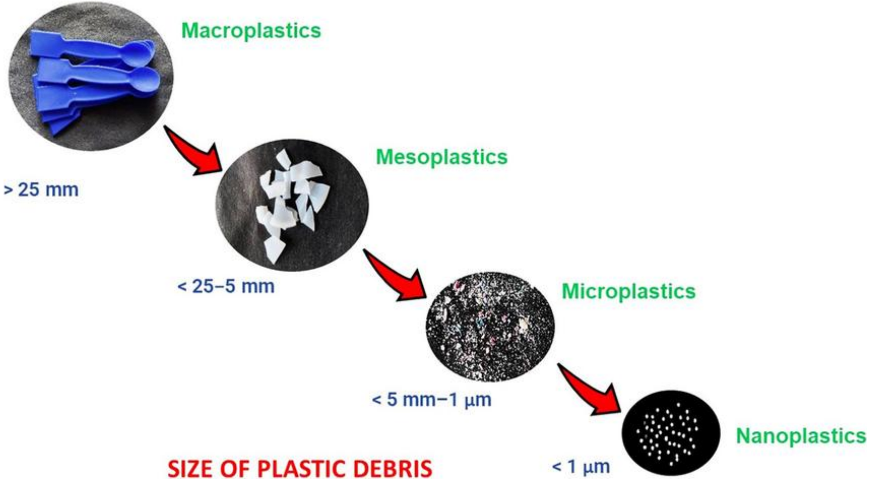
Key issues in QA/QC for microplastics research

- **Widespread contamination:** The high presence of microplastics in laboratory air, water, and on surfaces makes contamination a significant and pervasive problem that is difficult to eliminate.
- **Lack of standardisation:** There is no global consensus on standardised methods for sampling, processing, and analysis, which results in custom protocols that make it difficult to compare results between studies.
- **Data unreliability:** Without robust QA/QC measures like field and lab blanks, the measured microplastic levels can be incorrect, potentially overestimating the actual environmental presence of microplastics.
- **Inadequate reporting:** Many studies do not report their QA/QC procedures or the results from their blanks, and some even report contamination in their blanks, but do not account for it in their sample data.
- **Difficulty with correction:** The complexity of microplastics, which vary widely in size, shape, and composition, complicates the application of standard data correction methods used for other pollutants.

Microplastics Overview

What are microplastics?

Microplastics are plastic particles less than 5 millimetres in size that result from the breakdown of larger plastic items or from the manufacture of smaller plastic items, such as microbeads in cosmetics.



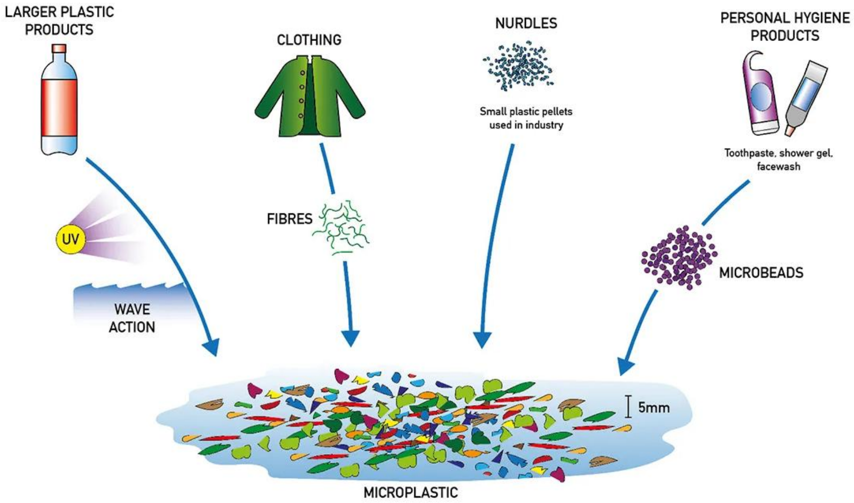
What are microplastics?

Primary microplastics: These are manufactured in small sizes to be used in products like exfoliating scrubs (microbeads), paint, and some textiles.

Secondary microplastics: These form when larger plastic items fragment into smaller pieces due to sun exposure and physical stress.

Where do they come from?

- Washing synthetic clothing can release microplastic fibres.
- Tyres on vehicles wear down, producing microplastics that end up in dust and water.
- Larger plastic items, like bags and bottles, break down over time.
- Pellets used in the manufacturing of other plastic products (called nurdles) can be released into the environment.
- Some cosmetics and cleaning products contain microbeads.

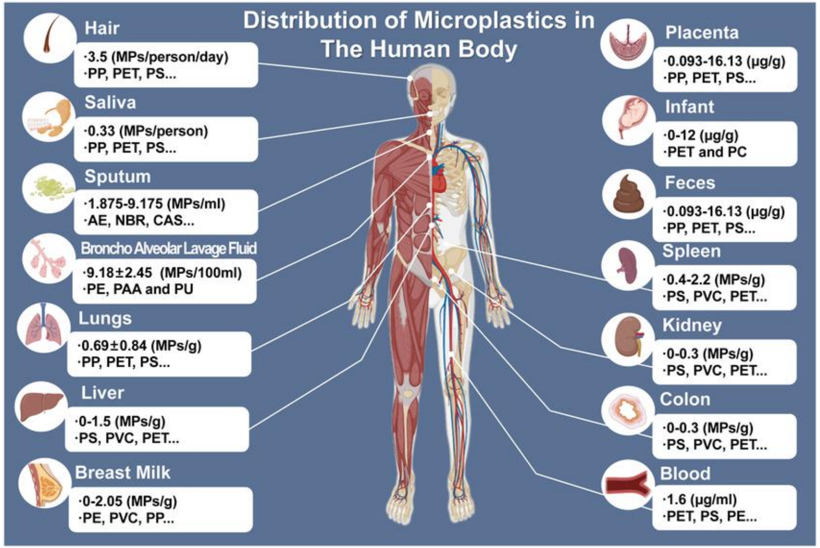


Where are they found?

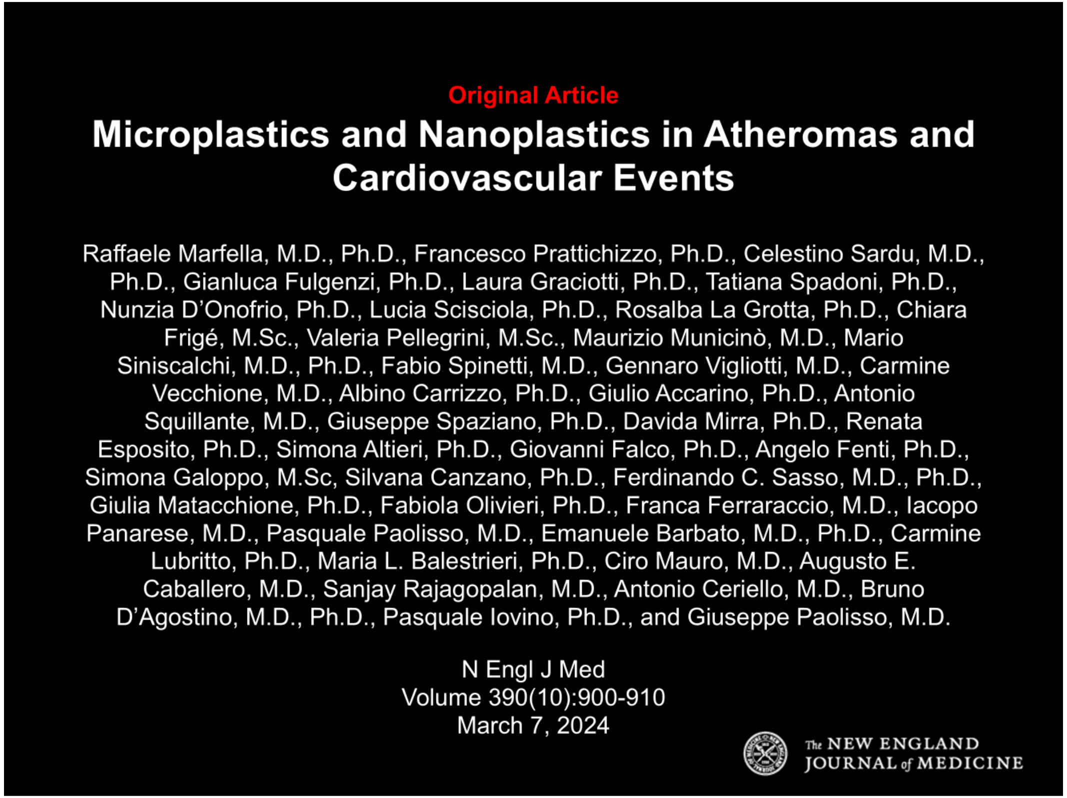
- Oceans, rivers, and lakes
- Soil
- The air
- Inside the human body through ingestion and inhalation
- Even in remote areas like Mount Everest

Potential concerns

- Microplastics can be ingested by marine life, leading to health effects.
- Scientists are concerned about the potential impacts on human health, as evidence shows they are present in human blood, breast milk, and other organs.
- While the long-term effects are still being researched, studies in animals and cells suggest potential links to issues like cancer and reproductive problems.



Potential concerns



Original Article

Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

Raffaele Marfella, M.D., Ph.D., Francesco Prattichizzo, Ph.D., Celestino Sardu, M.D., Ph.D., Gianluca Fulgenzi, Ph.D., Laura Graciotti, Ph.D., Tatiana Spadoni, Ph.D., Nunzia D'Onofrio, Ph.D., Lucia Scisciola, Ph.D., Rosalba La Grotta, Ph.D., Chiara Frigé, M.Sc., Valeria Pellegrini, M.Sc., Maurizio Municinò, M.D., Mario Siniscalchi, M.D., Ph.D., Fabio Spinetti, M.D., Gennaro Vigliotti, M.D., Carmine Vecchione, M.D., Albino Carrizzo, Ph.D., Giulio Accarino, Ph.D., Antonio Squillante, M.D., Giuseppe Spaziano, Ph.D., Davida Mirra, Ph.D., Renata Esposito, Ph.D., Simona Altieri, Ph.D., Giovanni Falco, Ph.D., Angelo Fenti, Ph.D., Simona Galoppo, M.Sc, Silvana Canzano, Ph.D., Ferdinando C. Sasso, M.D., Ph.D., Giulia Matacchione, Ph.D., Fabiola Olivieri, Ph.D., Franca Ferraraccio, M.D., Iacopo Panarese, M.D., Pasquale Paolisso, M.D., Emanuele Barbato, M.D., Ph.D., Carmine Lubritto, Ph.D., Maria L. Balestrieri, Ph.D., Ciro Mauro, M.D., Augusto E. Caballero, M.D., Sanjay Rajagopalan, M.D., Antonio Ceriello, M.D., Bruno D'Agostino, M.D., Ph.D., Pasquale Iovino, Ph.D., and Giuseppe Paolisso, M.D.

N Engl J Med
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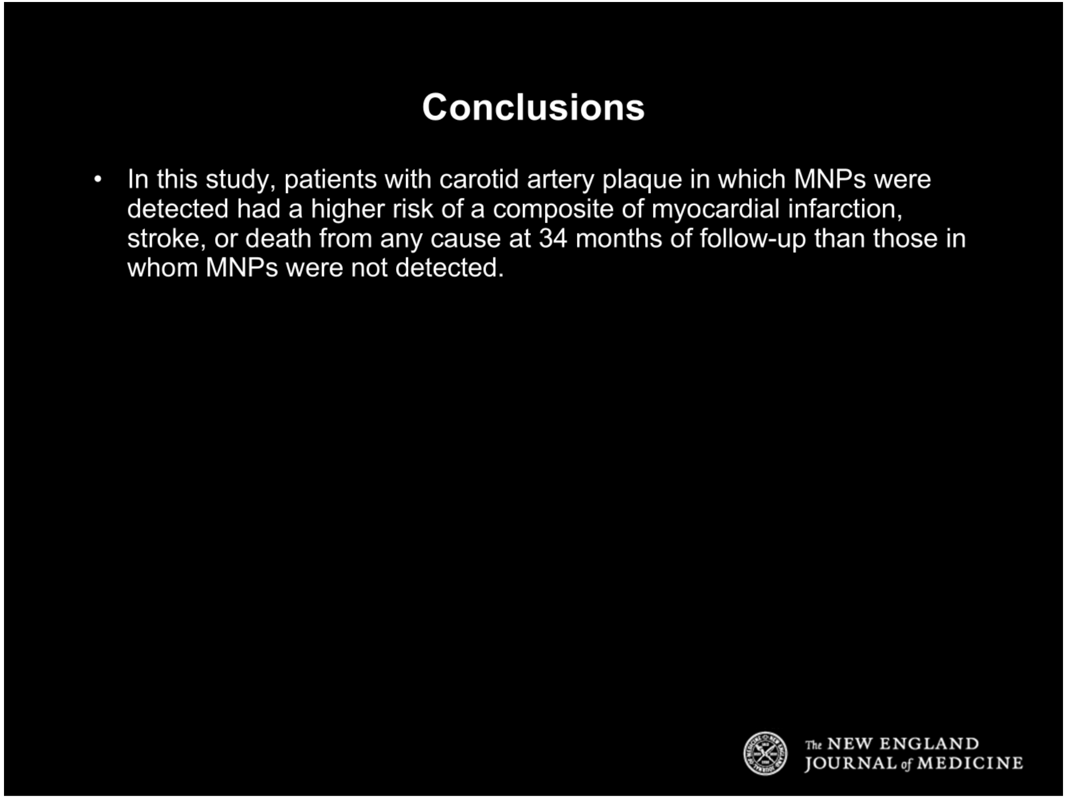
The NEW ENGLAND JOURNAL of MEDICINE

Potential concerns



Conclusions

- In this study, patients with carotid artery plaque in which MNPs were detected had a higher risk of a composite of myocardial infarction, stroke, or death from any cause at 34 months of follow-up than those in whom MNPs were not detected.

The NEW ENGLAND JOURNAL of MEDICINE

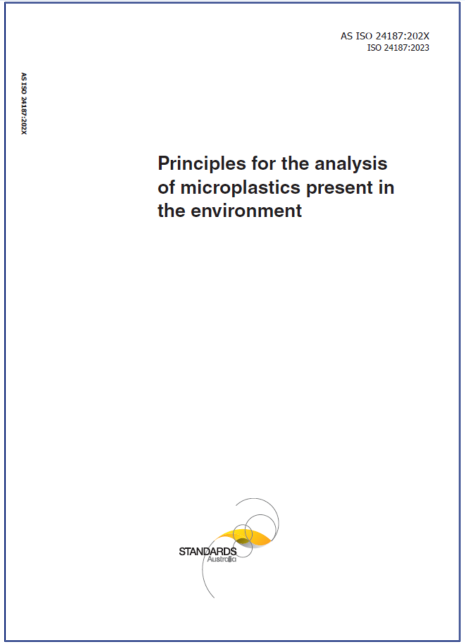
Microplastics – Definition AS ISO 24187

3.1
large microplastic

- any solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm
- Microplastics may show various shapes.
- Typically, a large microplastics object represents an item consisting of plastics or a part of an end-user product or a fragment of the respective item.

3.2
microplastic

- any solid plastic particle insoluble in water with a dimension between 1 µm and 1,000 µm (=1 mm)
- **Primary microplastics** object represents a particle intentionally added to end-user products for example cosmetic means, coatings, paints etc.
- **Secondary microplastics** object can also result as a fragment of the respective item.
- Microplastics have regular and irregular shapes (see ISO 9276-6:2008).
- The defined dimension is related to the longest length of the particle.



AS ISO 24187:202X
ISO 24187:2023

AS ISO 24187:202X

Principles for the analysis of microplastics present in the environment

STANDARDS Australia

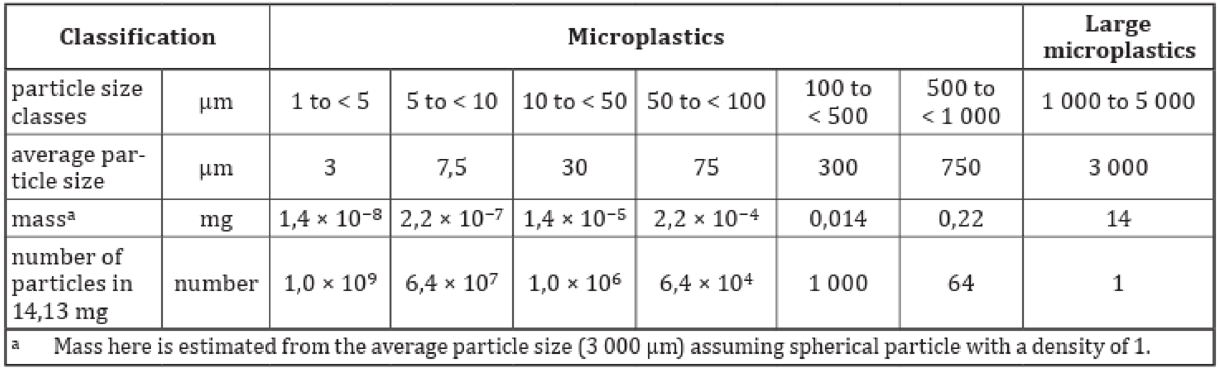
3 GOOD HEALTH AND WELL-BEING

6 CLEAN WATER AND SANITATION

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

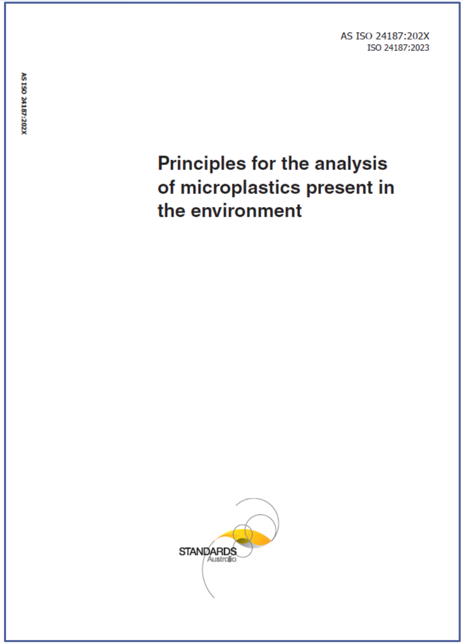
11 SUSTAINABLE CITIES AND COMMUNITIES

Microplastics – Definition AS ISO 24187



Classification		Microplastics						Large microplastics
particle size classes	µm	1 to < 5	5 to < 10	10 to < 50	50 to < 100	100 to < 500	500 to < 1 000	1 000 to 5 000
average particle size	µm	3	7,5	30	75	300	750	3 000
mass[a]	mg	$1,4 \times 10^{-8}$	$2,2 \times 10^{-7}$	$1,4 \times 10^{-5}$	$2,2 \times 10^{-4}$	0,014	0,22	14
number of particles in 14,13 mg	number	$1,0 \times 10^{9}$	$6,4 \times 10^{7}$	$1,0 \times 10^{6}$	$6,4 \times 10^{4}$	1 000	64	1

[a] Mass here is estimated from the average particle size (3 000 µm) assuming spherical particle with a density of 1.



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Principles for the analysis of microplastics present in the environment

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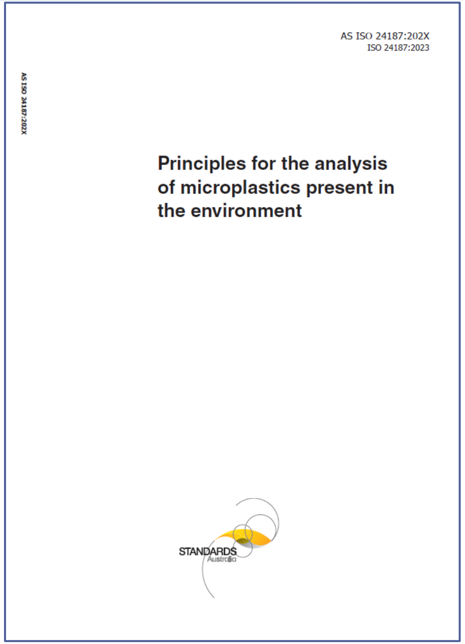
Microplastics – 6.2 Detection techniques

Spectroscopic methods can capture and assign the characteristics of specific chemical structures of polymers using reference spectra. Used methods are based on vibrational spectroscopy techniques (including on a microscopic level), including different measurement setups:

- Fourier transform infrared spectroscopy (FTIR);
- attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR);
- focal plane array detector Fourier transform infrared spectroscopy (FPA-FTIR);
- quantum cascade laser induced infrared spectroscopy (QCL-IR);
- near or short-wave infrared spectroscopy (NIR, SWIR);
- Raman spectroscopy.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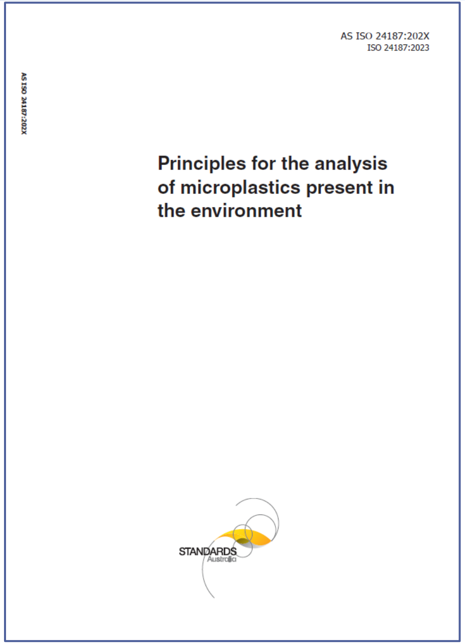
Principles for the analysis of microplastics present in the environment

STANDARDS Australia

Microplastics – 6.2 Detection techniques

In thermo-analytical methods, the sample is pyrolysed under inert conditions and specific decomposition products of the individual polymers are detected. Currently, well-established are gas chromatography-mass spectrometry (GC-MS) methods. They differ regarding the heating procedure (filament-based, micro furnace, Curie point), the sample amounts or sample preparation of individual selected or concentrated particles (pyrolysis - PYR-GC-MS), as well as pyrolysis of complete filter residues (thermal extraction desorption - TED-GC-MS).

Further methods are suitable, an alternative is the use of methods, which detect the specific melting process of semi-crystalline polymer materials (differential scanning calorimetry, DSC).



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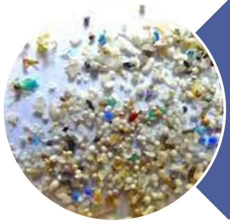
Microplastics in Cosmetics

Microplastics in Cosmetics - Prevalence

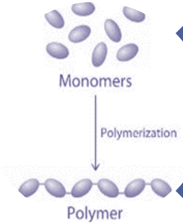
- Exfoliating Scrubs
- Toothpaste
- Shower Gels and Body Washes
- Cosmetic Glitter: Eye Shadows, Lip Glosses, and Nail Polishes

Microplastics in Cosmetics - Health Risks

Plastic Soup Foundation



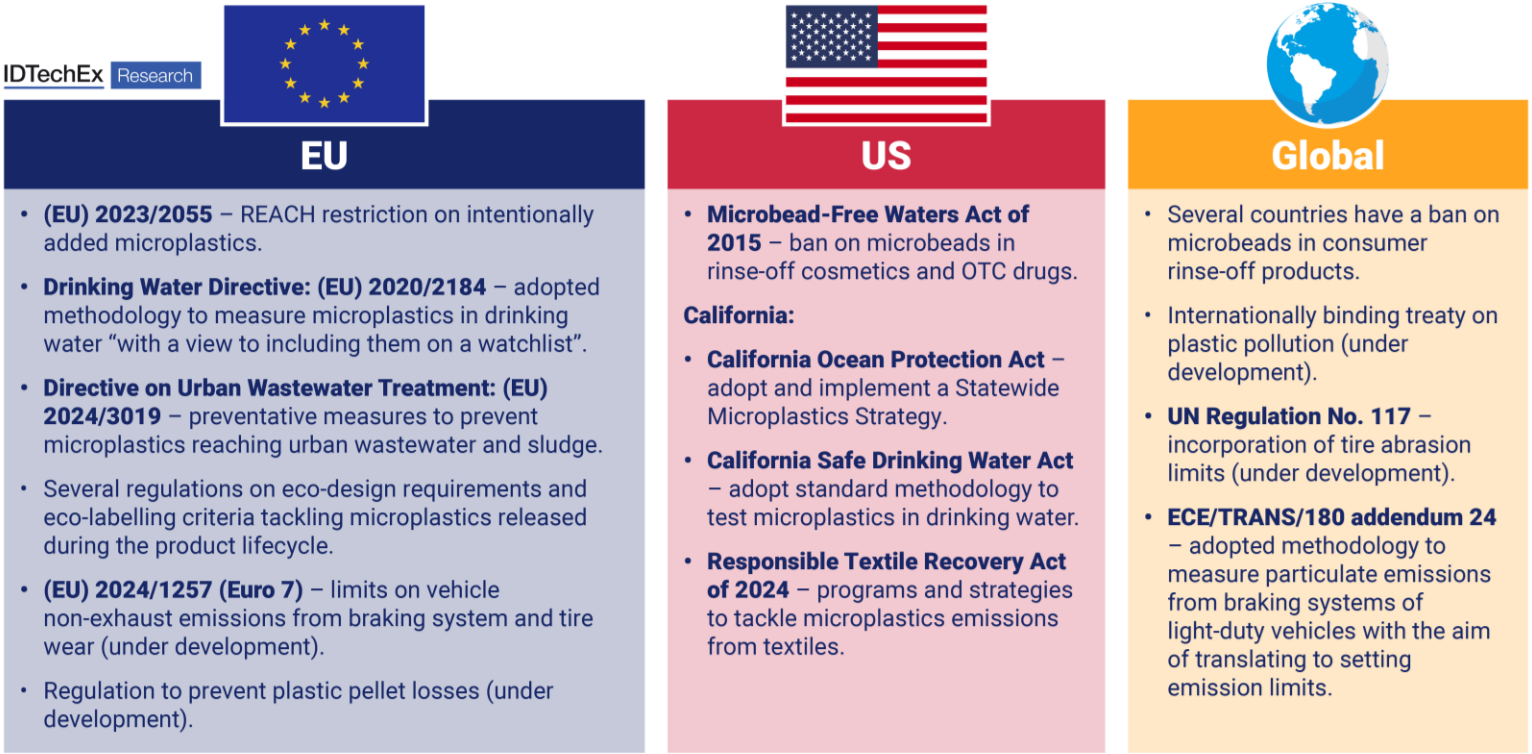
Particles themselves - physical hazard



Release unbound chemicals - monomers or additives

Adsorbed chemicals from the environment – e.g., POPs

Microplastics - Regulatory Challenges



IDTechEx Research

EU

- **(EU) 2023/2055** – REACH restriction on intentionally added microplastics.
- **Drinking Water Directive: (EU) 2020/2184** – adopted methodology to measure microplastics in drinking water “with a view to including them on a watchlist”.
- **Directive on Urban Wastewater Treatment: (EU) 2024/3019** – preventative measures to prevent microplastics reaching urban wastewater and sludge.
- Several regulations on eco-design requirements and eco-labelling criteria tackling microplastics released during the product lifecycle.
- **(EU) 2024/1257 (Euro 7)** – limits on vehicle non-exhaust emissions from braking system and tire wear (under development).
- Regulation to prevent plastic pellet losses (under development).

US

- **Microbead-Free Waters Act of 2015** – ban on microbeads in rinse-off cosmetics and OTC drugs.

California:

- **California Ocean Protection Act** – adopt and implement a Statewide Microplastics Strategy.
- **California Safe Drinking Water Act** – adopt standard methodology to test microplastics in drinking water.
- **Responsible Textile Recovery Act of 2024** – programs and strategies to tackle microplastics emissions from textiles.

Global

- Several countries have a ban on microbeads in consumer rinse-off products.
- Internationally binding treaty on plastic pollution (under development).
- **UN Regulation No. 117** – incorporation of tire abrasion limits (under development).
- **ECE/TRANS/180 addendum 24** – adopted methodology to measure particulate emissions from braking systems of light-duty vehicles with the aim of translating to setting emission limits.

Microplastics in Cosmetics - Regulatory Challenges

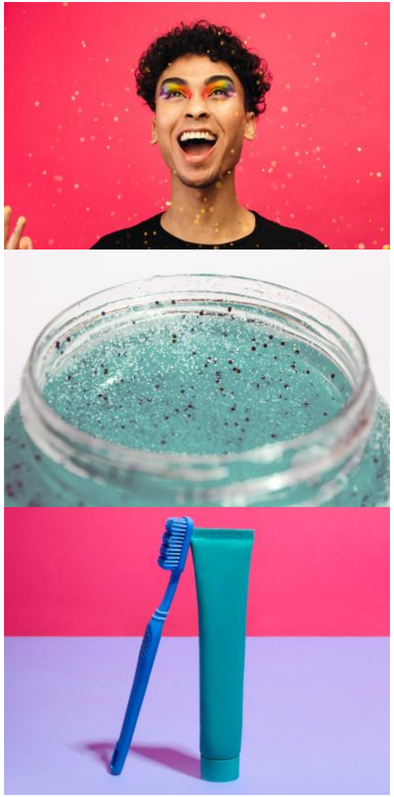
- Global efforts to increase recycling mandates and phase-out/ban single-use items
- Negotiations of the Global Plastics Treaty driven by the United Nations Environment Assembly

Europe:

- EU Regulation (EC) No 1907/2006: REACH Restriction on intentionally added microplastics (e.g., microbeads in cosmetics, glitter)

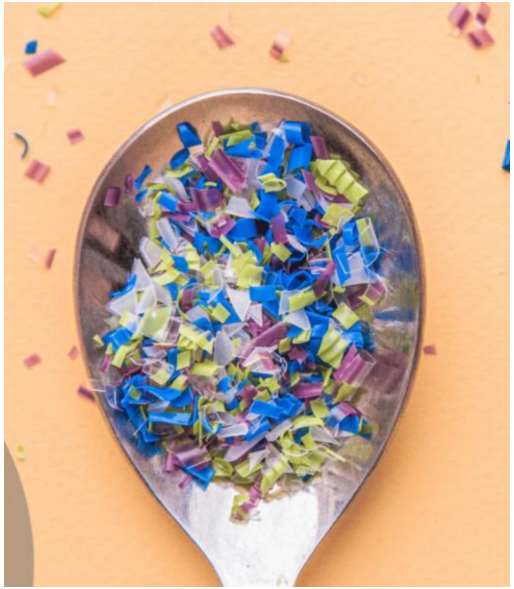
Canada:

- Canada Microbeads in Toiletries Regulations (SOR/2017-111) January 1, 2018



Microplastics in Cosmetics - Regulatory Challenges

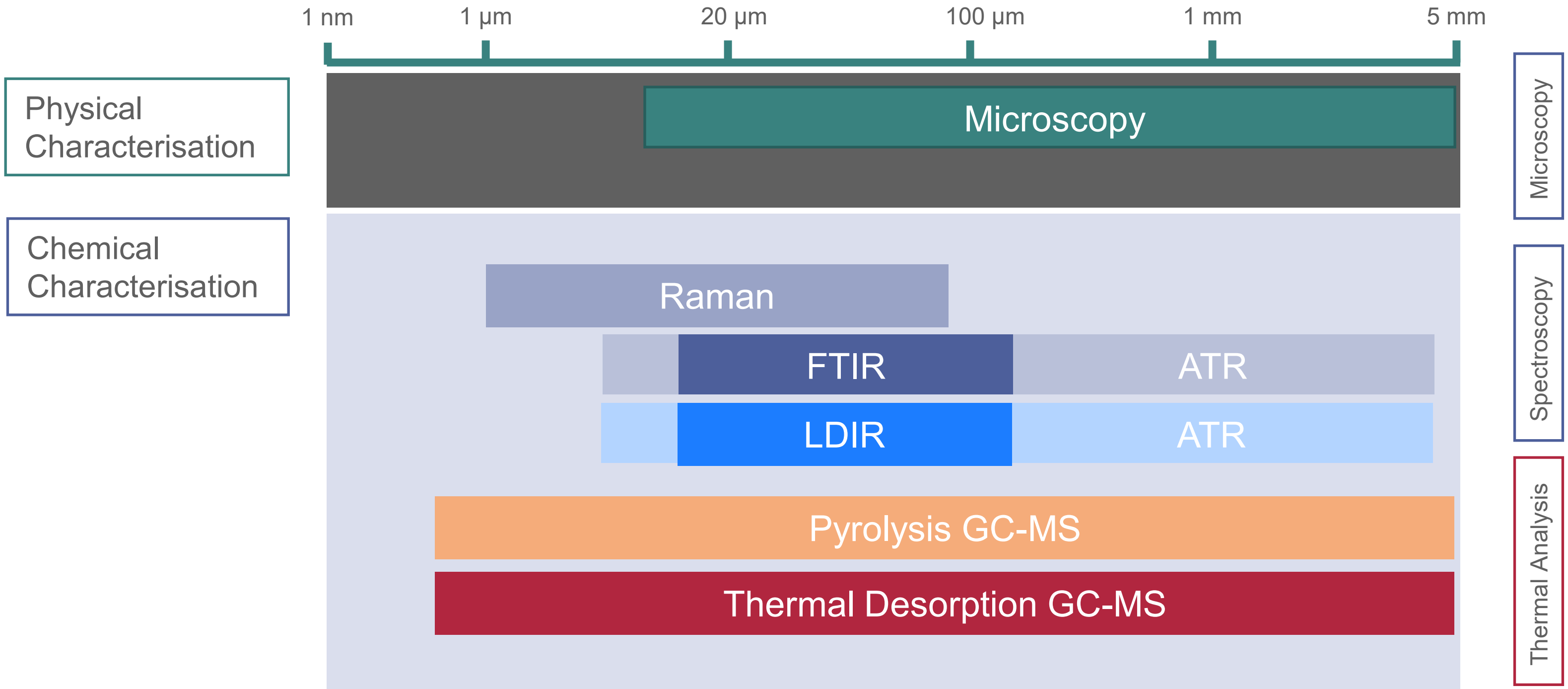
- Regulatory challenges for microplastics in Australian cosmetics include the narrow scope of existing bans, which primarily target solid plastic microbeads in rinse-off products, but do not cover newer microplastics like liquid polymers and powdered plastics used in leave-on products like makeup and sunscreen.
- Inconsistent state and federal regulations, the presence of non-compliant products in the market (like unauthorised imports), and the need for stronger enforcement are ongoing issues.

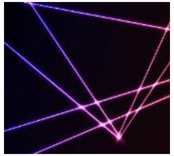


By Doctor's Desk
Aug 28, 2023

Analytical Methods

Microplastics in Cosmetics - Analysis



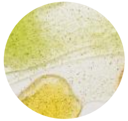


From BASEMAN (DELIVERABLE D4.3 Harmonized protocol for monitoring microplastics in biota)

Microplastics - Analysis

Published methods for Environmental Matrices:

- **ASTM D8332-20:** Standard Practice for Collection of Water Samples with High, Medium, or Low Suspended Solids for Identification and Quantification of Microplastic Particles and Fibers
- **SWB-MP1-rev1/ SWB-MP2-rev1:** Standard Operating Procedures for Extraction and Measurement by Infrared Spectroscopy/Raman of Microplastic Particles in Drinking Water by the State Water Resources Control Board in California
- **ASTM D8401-24:** Standard Test Method for Identification of Polymer Type and Quantity of Microplastic Particles and Fibers in Waters with High to Low Suspended Solids Using Pyrolysis-Gas Chromatography/Mass Spectrometry
- **ISO/TR 21960:2020** Plastics Environmental aspects State of knowledge and methodologies
- **ISO 24187:2023** Principles for the analysis of microplastics present in the environment



Published methods for Cosmetic Matrices:

- **Canada: Method 623.1**: Microbeads in toiletries

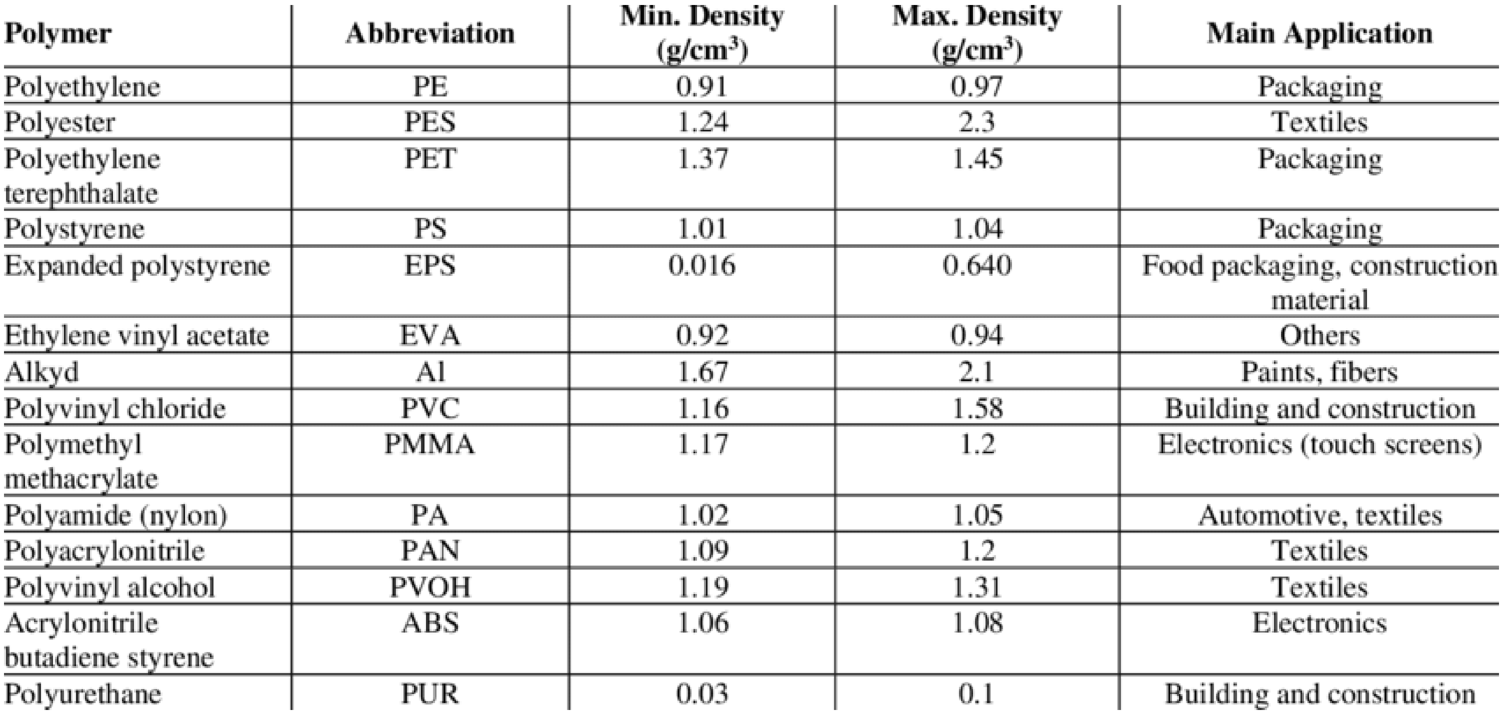
Microplastics in Cosmetics - Analysis

- The laboratory was established in our Melbourne Campus in **2019**
- Since November 2023 we have been **ISO/IEC 17025:2017 accredited for Microplastics Analysis in Potable and Environmental Water**

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Polymer densities



Polymer	Abbreviation	Min. Density (g/cm^3)	Max. Density (g/cm^3)	Main Application
Polyethylene	PE	0.91	0.97	Packaging
Polyester	PES	1.24	2.3	Textiles
Polyethylene terephthalate	PET	1.37	1.45	Packaging
Polystyrene	PS	1.01	1.04	Packaging
Expanded polystyrene	EPS	0.016	0.640	Food packaging, construction material
Ethylene vinyl acetate	EVA	0.92	0.94	Others
Alkyd	Al	1.67	2.1	Paints, fibers
Polyvinyl chloride	PVC	1.16	1.58	Building and construction
Polymethyl methacrylate	PMMA	1.17	1.2	Electronics (touch screens)
Polyamide (nylon)	PA	1.02	1.05	Automotive, textiles
Polyacrylonitrile	PAN	1.09	1.2	Textiles
Polyvinyl alcohol	PVOH	1.19	1.31	Textiles
Acrylonitrile butadiene styrene	ABS	1.06	1.08	Electronics
Polyurethane	PUR	0.03	0.1	Building and construction

Sample Preparation Methods

Step 1
- Drying
- Sieving

Step 2
- Digestion @65^{o}C
- H_2O_2, H_2O_2+$FeSO_4$, Enzymes

Step 3
- Water Rinsing
- Filtration

Step 4
- Air Drying

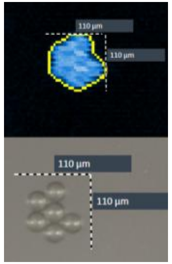
Step 5
- Identification + Counting
- LDIR Chemical Imaging system

Step 6
- QA/QC
- Reporting

Instrumentation

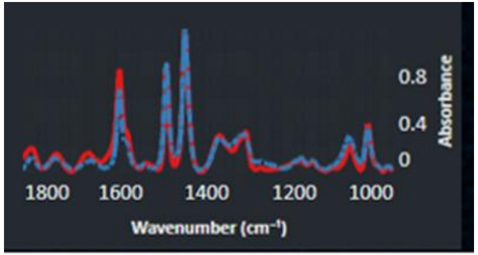
Laser Direct Infrared (LDIR) Chemical Imaging system

Imaging system: Particle enumeration and morphology



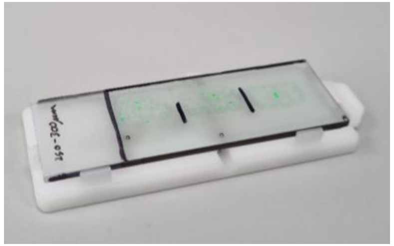
Information on:
- Number
- Size
- Morphology
- Colour

LDIR: Polymer identification



Library comparison – determination of polymer

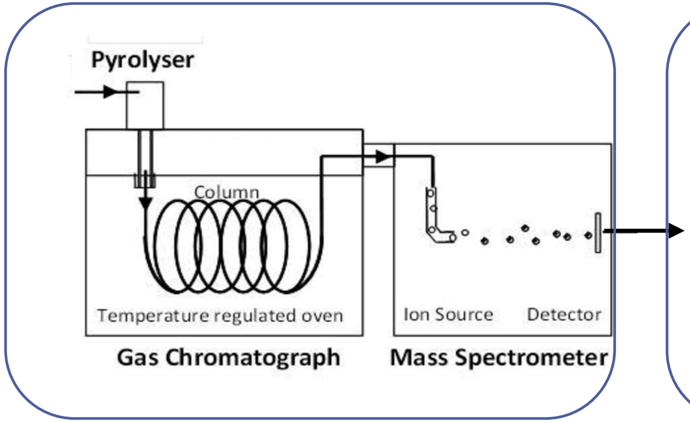
Information on:
- Type



Instrumentation

New

Pyrolysis – GC-MS/MS



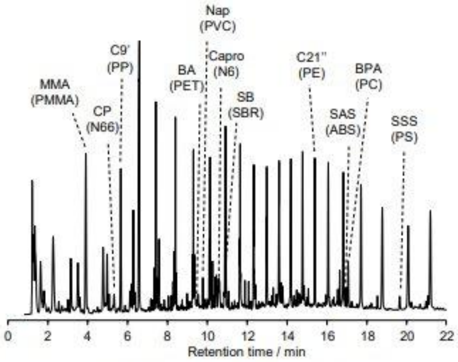
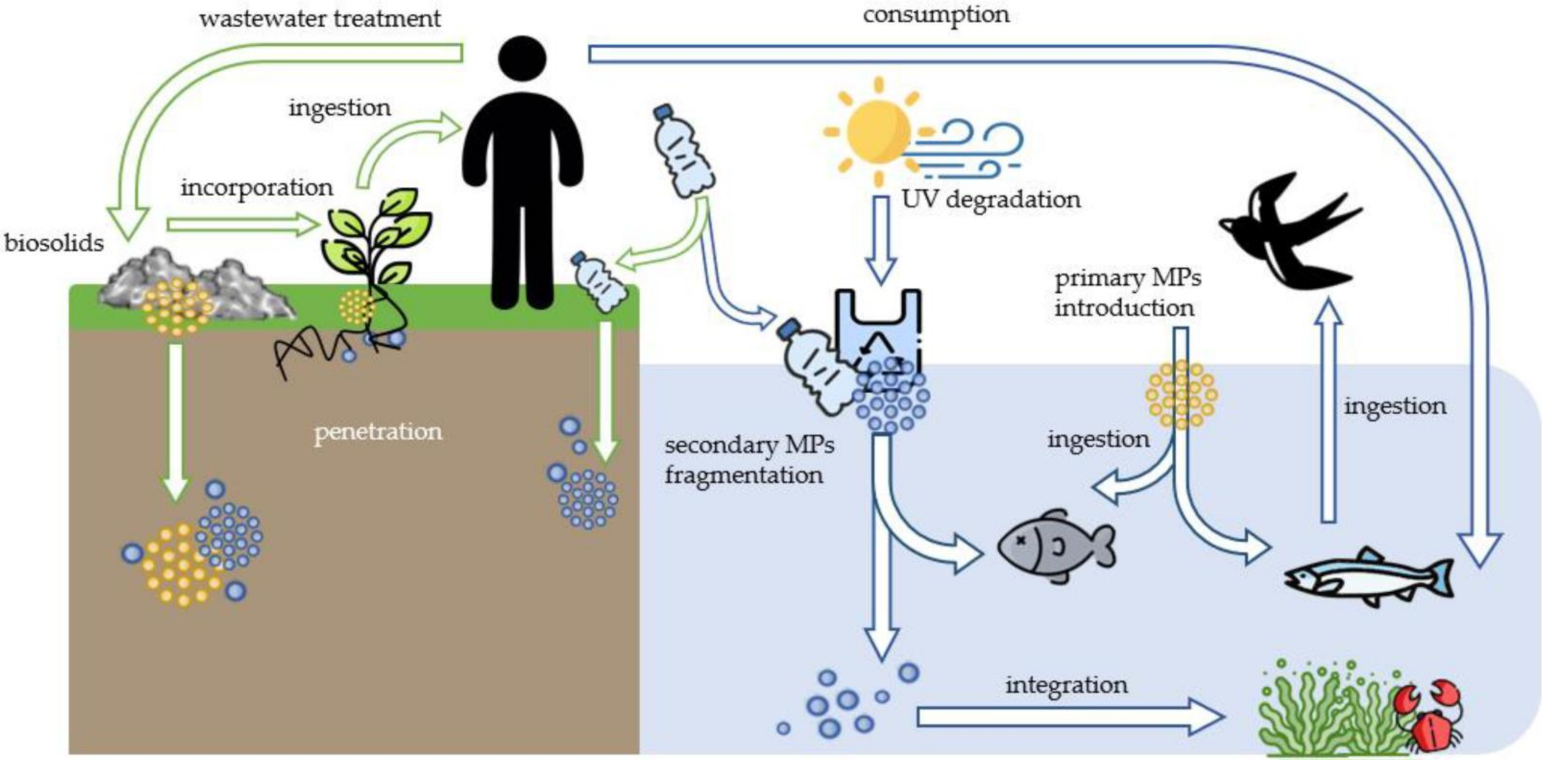


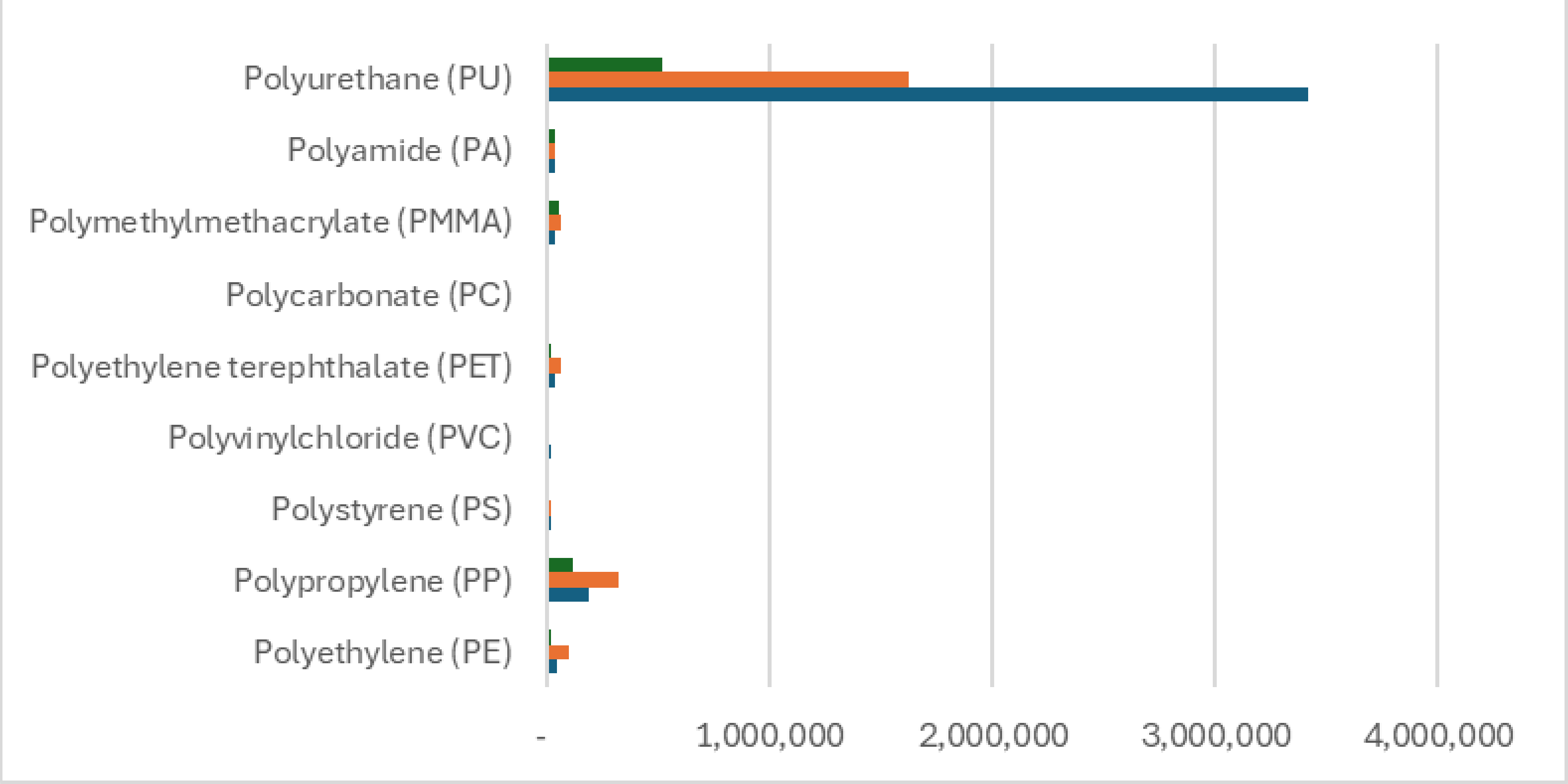
Fig. 2 Pyrogram of MPs-SiO2.

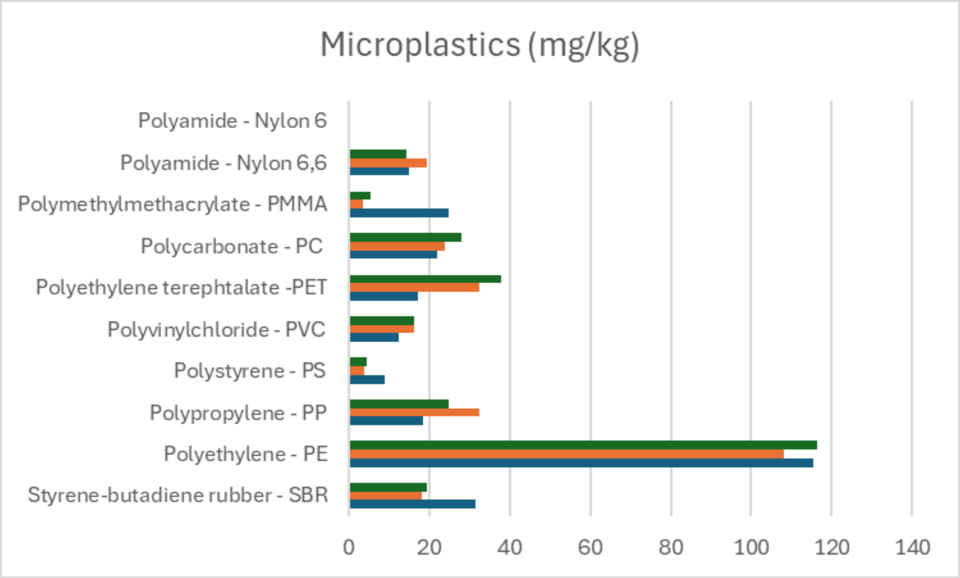
Information on:
- Type
- Concentration (µg/L, mg/kg)

Microplastics in biosolids



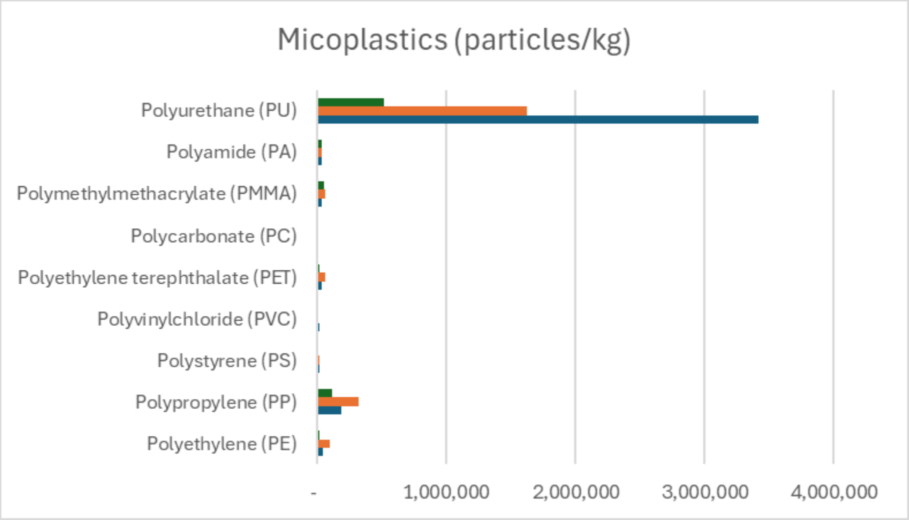
4 Trillion particles per tonne!!!



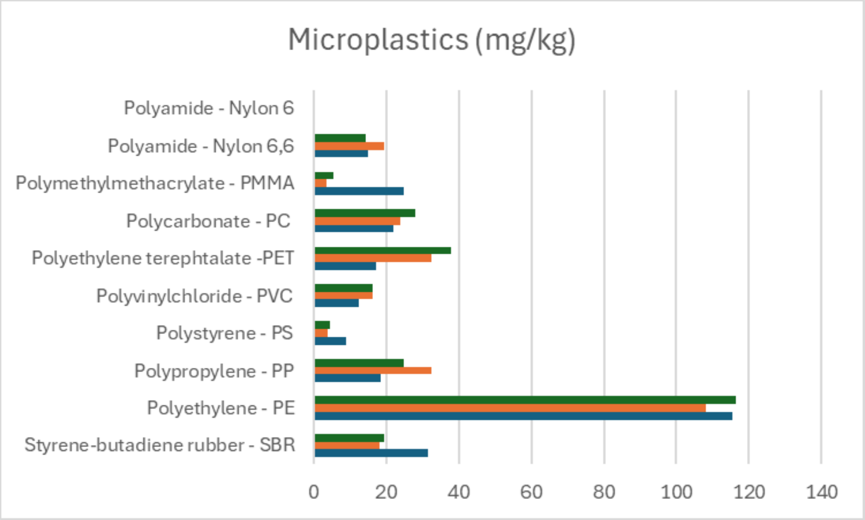

Microplastics (mg/kg)
Polyamide - Nylon 6
Polyamide - Nylon 6,6
Polymethylmethacrylate - PMMA
Polycarbonate - PC
Polyethylene terephtalate -PET
Polyvinylchloride - PVC
Polystyrene - PS
Polypropylene - PP
Polyethylene - PE
Styrene-butadiene rubber - SBR
0
20
40
60
80
100
120
140

Emerging Contaminants - Microplastics

LDIR



Pyrolysis – GC-MS/MS

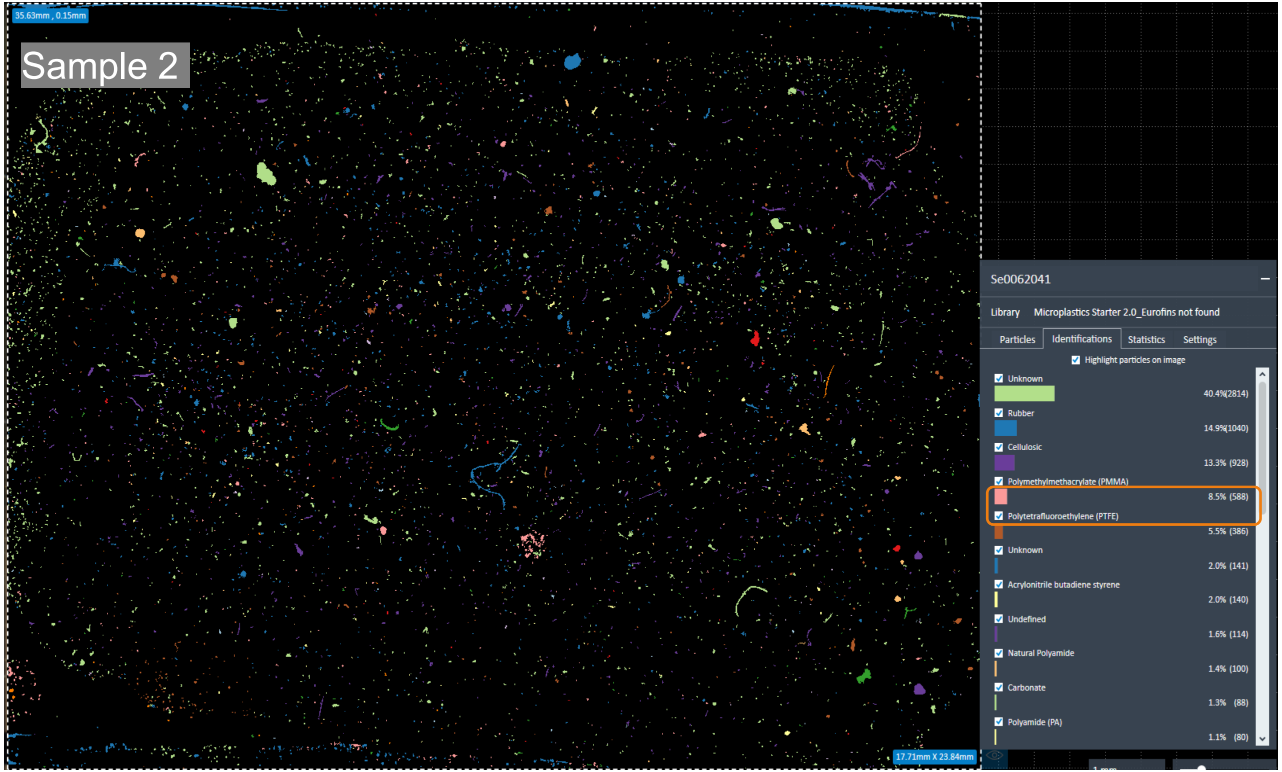


Interlaboratory/Proficiency Testing

Southern California Coastal Water Research Project (SCCWRP) 2021

WEPAL-QUASIMEME/NORMAN Interlaboratory Study on the Analysis of Microplastics in Environmental Matrices Round 2024

Microplastics in Cosmetics - Case Study



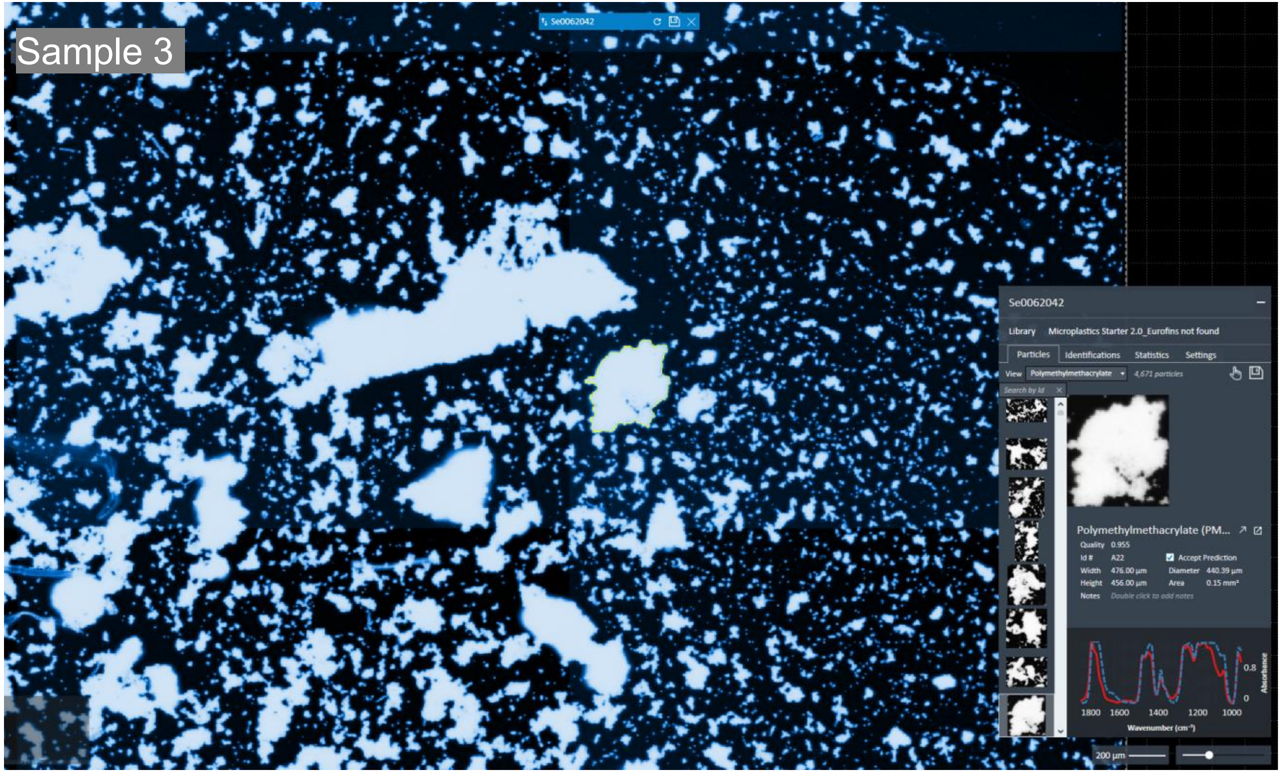
Se0062041

Library Microplastics Starter 2.0_Eurofins not found

☑ Highlight particles on image

☑ Unknown	40.4%(2814)
☑ Rubber	14.9%(1040)
☑ Cellulosic	13.3% (928)
☑ Polymethylmethacrylate (PMMA)	8.5% (588)
☑ Polytetrafluoroethylene (PTFE)	5.5% (386)
☑ Unknown	2.0% (141)
☑ Acrylonitrile butadiene styrene	2.0% (140)
☑ Undefined	1.6% (114)
☑ Natural Polyamide	1.4% (100)
☑ Carbonate	1.3% (88)
☑ Polyamide (PA)	1.1% (80)

Microplastics in Cosmetics - Case Study



Se0062042

Library Microplastics Starter 2.0_Eurofins not found

View Polymethylmethacrylate 4,671 particles

Polymethylmethacrylate (PM...

Quality 0.955

Id # A22 ☑ Accept Prediction

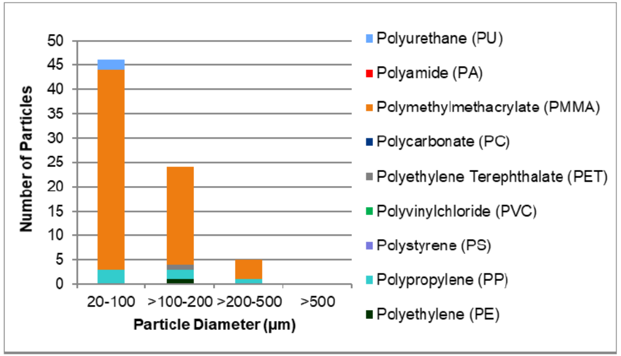
Width 476.00 µm Diameter 440.39 µm

Height 456.00 µm Area 0.15 mm²

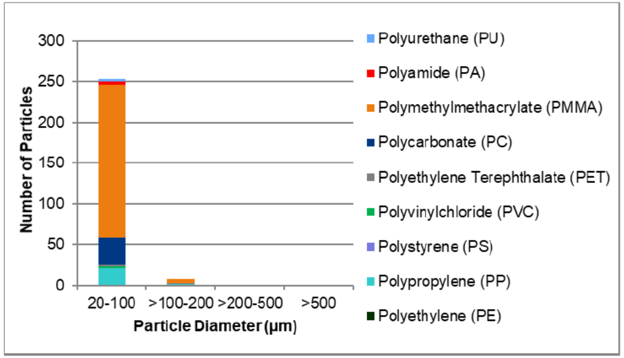
Notes *Double click to add notes*

Microplastics in Cosmetics - Case Study

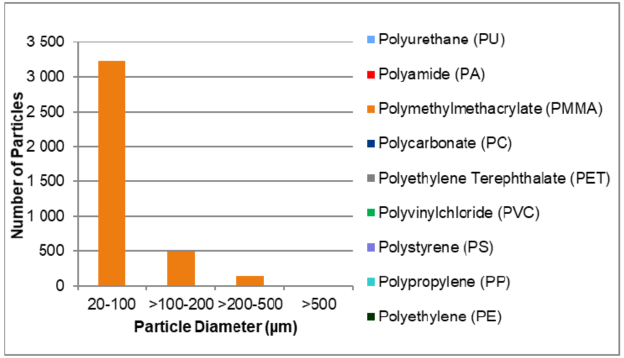
Sample 1



Sample 2



Sample 3



Intentionally added vs incidental contamination???

Plastics Plan 2.0 – NSW EPA

The NSW EPA's plastics legislation is primarily under the Plastic Reduction and Circular Economy Act 2021 (PRCE Act) 2021, which introduced a phased ban on single-use plastics starting in mid-2022. Recent updates and proposed actions under Plastics Plan 2.0 include phasing out additional items, such as plastic bread tags and pizza savers, by 2027, mandating tethered lids on bottles by 2030, and introducing new regulations on harmful chemicals and **microplastics**.

Current legislation and recent changes

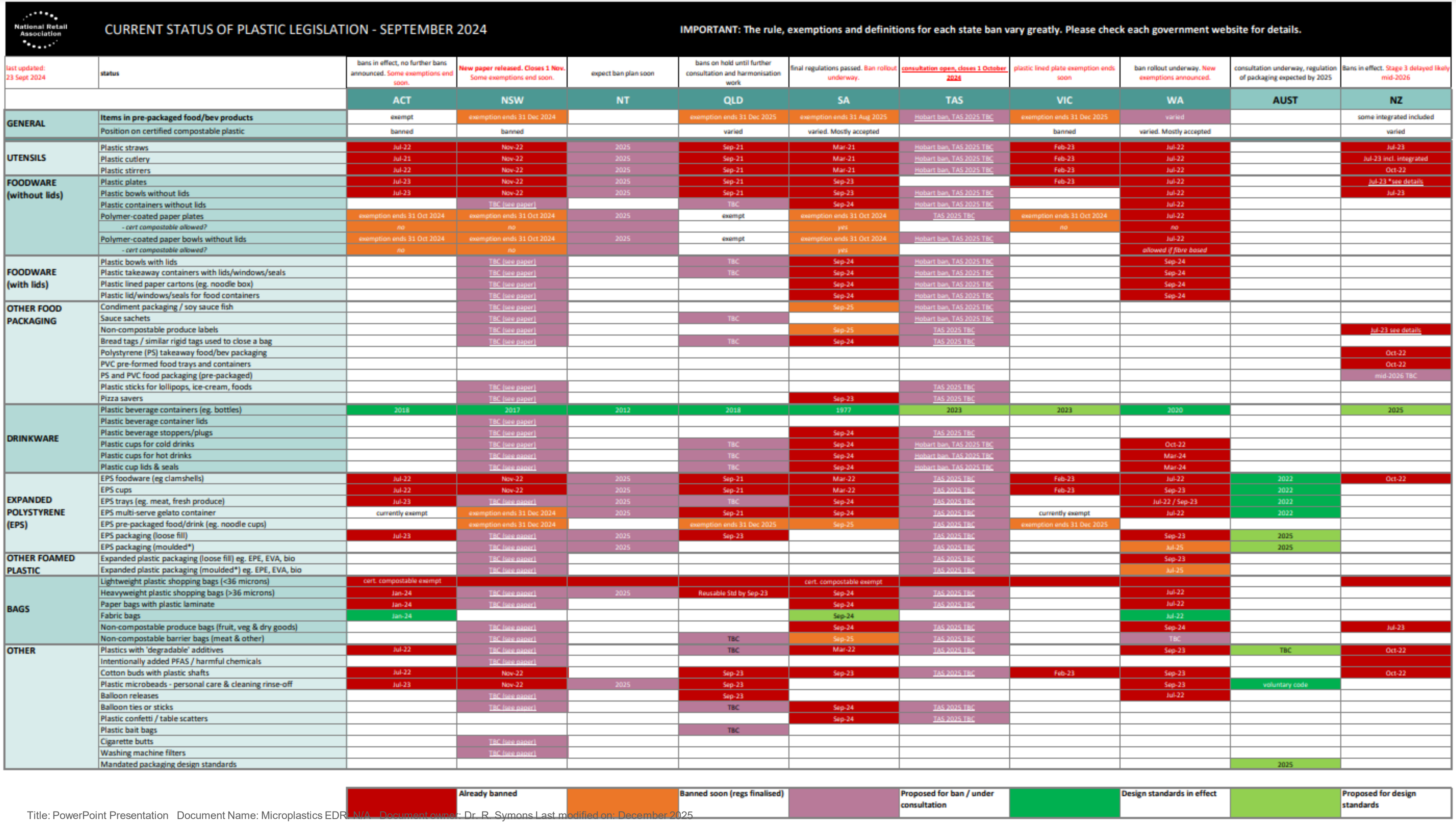
Initial bans: Since 2022, bans have been implemented on lightweight plastic bags, straws, stirrers, cutlery, plates, and expanded polystyrene (EPS) food service ware.

Integrated packaging: As of January 1, 2025, the transition period for banned plastic items integrated into packaged food and drinks has ended, meaning these are no longer permitted.

Microplastics: A ban on plastic microbeads in rinse-off personal care products has been in place since November 2022.

Microbeads

Plastic microbeads in rinse-off personal care products are banned in states & territories like NSW, ACT, WA, and Queensland, due to their environmental impact, as water treatment systems cannot capture them. The bans resulted from a 2016 agreement for a voluntary industry phase-out led by Accord Australasia, followed by state-level legislation to ensure compliance. Despite the bans, some products have recently been found to contain microbeads, and authorities are issuing compliance notices and taking enforcement action against retailers.



National Retail Association

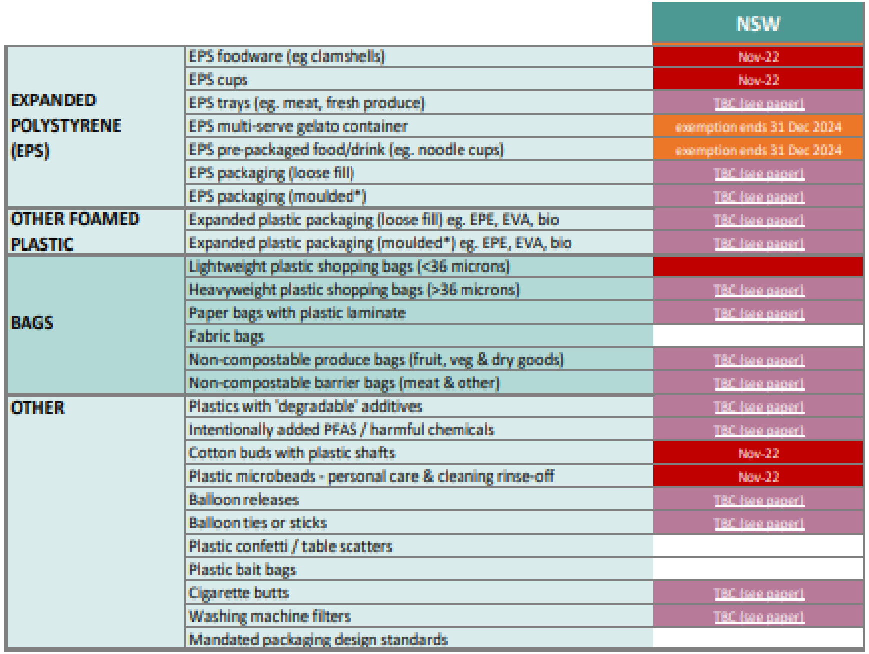
CURRENT STATUS OF PLASTIC LEGISLATION - SEPTEMBER 2024

IMPORTANT: The rule, exemptions and definitions for each state ban vary greatly. Please check each government website for details.

last updated: 23 Sept 2024	status	bans in effect, no further bans announced. Some exemptions end soon.	New paper released. Closes 1 Nov. Some exemptions end soon.	expect ban plan soon	bans on hold until further consultation and harmonisation work	final regulations passed. Ban rollout underway.	consultation open, closes 1 October 2024	plastic lined plate exemption ends soon	ban rollout underway. New exemptions announced.	consultation underway, regulation of packaging expected by 2025	Bans in effect. Stage 3 delayed likely mid-2026
		ACT	**NSW**	**NT**	**QLD**	**SA**	**TAS**	**VIC**	**WA**	**AUST**	**NZ**
GENERAL	**Items in pre-packaged food/bev products**	exempt	exemption ends 31 Dec 2024		exemption ends 31 Dec 2025	exemption ends 31 Aug 2025	Hobart ban, TAS 2025 TBC	exemption ends 31 Dec 2025	varied		some integrated included
	Position on certified compostable plastic	banned	banned		varied	varied. Mostly accepted		banned	varied. Mostly accepted		varied
UTENSILS	Plastic straws	Jul-22	Nov-22	2025	Sep-21	Mar-21	Hobart ban, TAS 2025 TBC	Feb-23	Jul-22		Jul-23
	Plastic cutlery	Jul-21	Nov-22	2025	Sep-21	Mar-21	Hobart ban, TAS 2025 TBC	Feb-23	Jul-22		Jul-23 incl. integrated
	Plastic stirrers	Jul-22	Nov-22	2025	Sep-21	Mar-21	Hobart ban, TAS 2025 TBC	Feb-23	Jul-22		Oct-22
FOODWARE (without lids)	Plastic plates	Jul-23	Nov-22	2025	Sep-21	Sep-23		Feb-23	Jul-22		Jul-23 *see details
	Plastic bowls without lids	Jul-23	Nov-22	2025	Sep-21	Sep-23	Hobart ban, TAS 2025 TBC		Jul-22		Jul-23
	Plastic containers without lids		TBC (see paper)		TBC	Sep-24	Hobart ban, TAS 2025 TBC		Jul-22		
	Polymer-coated paper plates	exemption ends 31 Oct 2024	exemption ends 31 Oct 2024	2025	exempt	exemption ends 31 Oct 2024	TAS 2025 TBC	exemption ends 31 Oct 2024	Jul-22		
	- cert compostable allowed?	*no*	*no*	🟪		*yes*		*no*	*no*		
	Polymer-coated paper bowls without lids	exemption ends 31 Oct 2024	exemption ends 31 Oct 2024	2025	exempt	exemption ends 31 Oct 2024	Hobart ban, TAS 2025 TBC		Jul-22		
	- cert compostable allowed?	*no*	*no*	🟪		*yes*			*allowed if fibre based*		
FOODWARE (with lids)	Plastic bowls with lids		TBC (see paper)		TBC	Sep-24	Hobart ban, TAS 2025 TBC		Sep-24		
	Plastic takeaway containers with lids/windows/seals		TBC (see paper)		TBC	Sep-24	Hobart ban, TAS 2025 TBC		Sep-24		
	Plastic lined paper cartons (eg. noodle box)		TBC (see paper)			Sep-24	Hobart ban, TAS 2025 TBC		Sep-24		
	Plastic lid/windows/seals for food containers		TBC (see paper)			Sep-24	Hobart ban, TAS 2025 TBC		Sep-24		
OTHER FOOD PACKAGING	Condiment packaging / soy sauce fish		TBC (see paper)			Sep-25	Hobart ban, TAS 2025 TBC				
	Sauce sachets		TBC (see paper)		TBC		Hobart ban, TAS 2025 TBC				
	Non-compostable produce labels		TBC (see paper)			Sep-25	TAS 2025 TBC				Jul-23 see details
	Bread tags / similar rigid tags used to close a bag		TBC (see paper)		TBC	Sep-24	TAS 2025 TBC				
	Polystyrene (PS) takeaway food/bev packaging										Oct-22
	PVC pre-formed food trays and containers										Oct-22
	PS and PVC food packaging (pre-packaged)										mid-2026 TBC
	Plastic sticks for lollipops, ice-cream, foods		TBC (see paper)				TAS 2025 TBC				
	Pizza savers		TBC (see paper)			Sep-23	TAS 2025 TBC				
DRINKWARE	Plastic beverage containers (eg. bottles)	2018	2017	2012	2018	1977	2023	2023	2020		2025
	Plastic beverage container lids		TBC (see paper)								
	Plastic beverage stoppers/plugs		TBC (see paper)			Sep-24	TAS 2025 TBC				
	Plastic cups for cold drinks		TBC (see paper)		TBC	Sep-24	Hobart ban, TAS 2025 TBC		Oct-22		
	Plastic cups for hot drinks		TBC (see paper)		TBC	Sep-24	Hobart ban, TAS 2025 TBC		Mar-24		
	Plastic cup lids & seals		TBC (see paper)		TBC	Sep-24	Hobart ban, TAS 2025 TBC		Mar-24		
EXPANDED POLYSTYRENE (EPS)	EPS foodware (eg clamshells)	Jul-22	Nov-22	2025	Sep-21	Mar-22	TAS 2025 TBC	Feb-23	Jul-22	2022	Oct-22
	EPS cups	Jul-22	Nov-22	2025	Sep-21	Mar-22	TAS 2025 TBC	Feb-23	Sep-23	2022	
	EPS trays (eg. meat, fresh produce)	Jul-23	TBC (see paper)	2025	TBC	Sep-24	TAS 2025 TBC		Jul-22 / Sep-23	2022	
	EPS multi-serve gelato container	currently exempt	exemption ends 31 Dec 2024	2025	Sep-21	Sep-24	TAS 2025 TBC	currently exempt	Jul-22	2022	
	EPS pre-packaged food/drink (eg. noodle cups)		exemption ends 31 Dec 2024		exemption ends 31 Dec 2025	Sep-25	TAS 2025 TBC	exemption ends 31 Dec 2025			
	EPS packaging (loose fill)	Jul-23	TBC (see paper)	2025	Sep-23		TAS 2025 TBC		Sep-23	2025	
	EPS packaging (moulded*)		TBC (see paper)	2025			TAS 2025 TBC		Jul-25	2025	
OTHER FOAMED PLASTIC	Expanded plastic packaging (loose fill) eg. EPE, EVA, bio		TBC (see paper)				TAS 2025 TBC		Sep-23		
	Expanded plastic packaging (moulded*) eg. EPE, EVA, bio		TBC (see paper)				TAS 2025 TBC		Jul-25		
BAGS	Lightweight plastic shopping bags (<36 microns)	cert. compostable exempt	🟥	🟥	🟥	cert. compostable exempt	🟥	🟥	🟥		🟥
	Heavyweight plastic shopping bags (>36 microns)	Jan-24	TBC (see paper)	2025	Reusable Std by Sep-23	Sep-24	TAS 2025 TBC		Jul-22		
	Paper bags with plastic laminate	Jan-24	TBC (see paper)			Sep-24	TAS 2025 TBC		Jul-22		
	Fabric bags	Jan-24				Sep-24			Jul-22		
	Non-compostable produce bags (fruit, veg & dry goods)		TBC (see paper)			Sep-24	TAS 2025 TBC		Sep-24		Jul-23
	Non-compostable barrier bags (meat & other)		TBC (see paper)		TBC	Sep-25	TAS 2025 TBC		TBC		
OTHER	Plastics with 'degradable' additives	Jul-22	TBC (see paper)		TBC	Mar-22	TAS 2025 TBC		Sep-23	TBC	Oct-22
	Intentionally added PFAS / harmful chemicals		TBC (see paper)								🟥
	Cotton buds with plastic shafts	Jul-22	Nov-22		Sep-23	Sep-23	TAS 2025 TBC	Feb-23	Sep-23		Oct-22
	Plastic microbeads - personal care & cleaning rinse-off	Jul-23	Nov-22	2025	Sep-23				Sep-23	voluntary code	
	Balloon releases		TBC (see paper)		Sep-23				Jul-22		
	Balloon ties or sticks		TBC (see paper)		TBC	Sep-24	TAS 2025 TBC				
	Plastic confetti / table scatters					Sep-24	TAS 2025 TBC				
	Plastic bait bags				TBC						
	Cigarette butts		TBC (see paper)								
	Washing machine filters		TBC (see paper)								
	Mandated packaging design standards									2025	

🟥	**Already banned**	🟧	**Banned soon (regs finalised)**	🟪	**Proposed for ban / under consultation**	🟩	**Design standards in effect**	🟩	**Proposed for design standards**

		NSW
GENERAL	**Items in pre-packaged food/bev products**	exemption ends 31 Dec 2024
	Position on certified compostable plastic	banned
UTENSILS	Plastic straws	Nov-22
	Plastic cutlery	Nov-22
	Plastic stirrers	Nov-22
FOODWARE (without lids)	Plastic plates	Nov-22
	Plastic bowls without lids	Nov-22
	Plastic containers without lids	TBC (see paper)
	Polymer-coated paper plates	exemption ends 31 Oct 2024
	- cert compostable allowed?	no
	Polymer-coated paper bowls without lids	exemption ends 31 Oct 2024
	- cert compostable allowed?	no
FOODWARE (with lids)	Plastic bowls with lids	TBC (see paper)
	Plastic takeaway containers with lids/windows/seals	TBC (see paper)
	Plastic lined paper cartons (eg. noodle box)	TBC (see paper)
	Plastic lid/windows/seals for food containers	TBC (see paper)
OTHER FOOD PACKAGING	Condiment packaging / soy sauce fish	TBC (see paper)
	Sauce sachets	TBC (see paper)
	Non-compostable produce labels	TBC (see paper)
	Bread tags / similar rigid tags used to close a bag	TBC (see paper)
	Polystyrene (PS) takeaway food/bev packaging	
	PVC pre-formed food trays and containers	
	PS and PVC food packaging (pre-packaged)	
	Plastic sticks for lollipops, ice-cream, foods	TBC (see paper)
	Pizza savers	TBC (see paper)
DRINKWARE	Plastic beverage containers (eg. bottles)	2017
	Plastic beverage container lids	TBC (see paper)
	Plastic beverage stoppers/plugs	TBC (see paper)
	Plastic cups for cold drinks	TBC (see paper)
	Plastic cups for hot drinks	TBC (see paper)
	Plastic cup lids & seals	TBC (see paper)

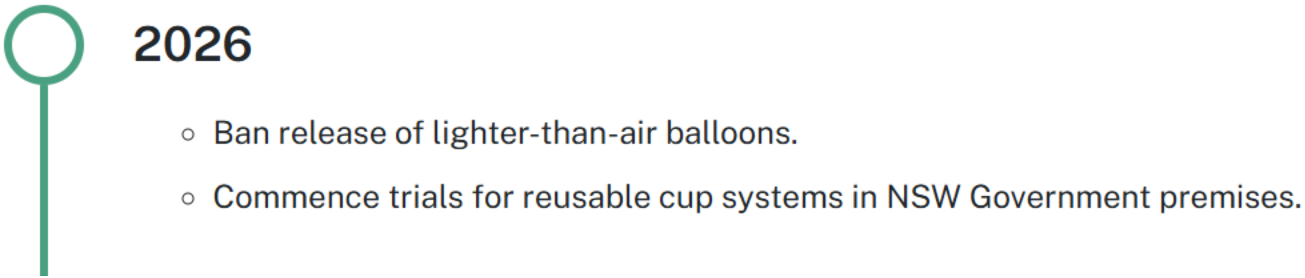


		NSW
EXPANDED POLYSTYRENE (EPS)	EPS foodware (eg clamshells)	Nov-22
	EPS cups	Nov-22
	EPS trays (eg. meat, fresh produce)	TBC (see paper)
	EPS multi-serve gelato container	exemption ends 31 Dec 2024
	EPS pre-packaged food/drink (eg. noodle cups)	exemption ends 31 Dec 2024
	EPS packaging (loose fill)	TBC (see paper)
	EPS packaging (moulded*)	TBC (see paper)
OTHER FOAMED PLASTIC	Expanded plastic packaging (loose fill) eg. EPE, EVA, bio	TBC (see paper)
	Expanded plastic packaging (moulded*) eg. EPE, EVA, bio	TBC (see paper)
BAGS	Lightweight plastic shopping bags (<36 microns)	🟥
	Heavyweight plastic shopping bags (>36 microns)	TBC (see paper)
	Paper bags with plastic laminate	TBC (see paper)
	Fabric bags	
	Non-compostable produce bags (fruit, veg & dry goods)	TBC (see paper)
	Non-compostable barrier bags (meat & other)	TBC (see paper)
OTHER	Plastics with 'degradable' additives	TBC (see paper)
	Intentionally added PFAS / harmful chemicals	TBC (see paper)
	Cotton buds with plastic shafts	Nov-22
	Plastic microbeads - personal care & cleaning rinse-off	Nov-22
	Balloon releases	TBC (see paper)
	Balloon ties or sticks	TBC (see paper)
	Plastic confetti / table scatters	
	Plastic bait bags	
	Cigarette butts	TBC (see paper)
	Washing machine filters	TBC (see paper)
	Mandated packaging design standards	

Compliance Notices issued under the PRCE Act

Compliance Notices issued under the PRCE Act

Future proposed legislation under Plastics Plan 2.0



2026

- Ban release of lighter-than-air balloons.
- Commence trials for reusable cup systems in NSW Government premises.

Future proposed legislation under Plastics Plan 2.0

Commence regulations phasing out the supply of the following items from late 2027

- plastics containing pro-degradant additives
- rinse-off cleaning products containing plastic microbeads
- plastic bags with handles, regardless of thickness
- plastic umbrella bags
- plastic pizza savers
- plastic tags used to seal bags containing bread, bakery, and dry pantry items (with a temporary exemption for bags containing fresh produce to September 2029)
- plastic balloon sticks and ties
- loose-fill and void-fill packaging made from expanded or foamed plastic
- food supply and service items, such as food trays, made from expanded or foamed plastic

Establish a reuse-only precinct in the Sydney CBD in late 2027.

Identify and prioritise chemicals of concern in food and beverage packaging items.

Future proposed legislation under Plastics Plan 2.0

Chemicals and microfibres:

Regulate harmful chemical additives in packaging.

Phase out oxo-, photo-, and landfill-degradable plastics.

Introduce a design standard for washing machines to reduce microfibres.

Summary

- Microplastics is a critical public health and environmental issue.
- NSW EPA Plastic 2.0 will set the scene for greater levels of scrutiny over the next few years.
- New EU regulations (2026) are a game-changer, demanding robust analytical science for compliance.
- Success requires collaboration between researchers, regulators, and industry to ensure food safety, drive innovation, and protect human health.

Thank you for your attention!