MICROPLASTICS AND NANOPLASTICS: ENVIRONMENTAL AND HEALTH CONCERNS, REGULATIONS, AND TESTING

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1. EXECUTIVE SUMMARY

Microplastics and nanoplastics are now widely recognized as pervasive environmental contaminants, infiltrating terrestrial, aquatic, and atmospheric ecosystems, with increasing evidence of their accumulation in human tissues. These small synthetic particles originate from numerous sources, including plastic degradation, industrial processes, and consumer products. Nanoplastics arise from the further breakdown of microplastics, fragmenting into even smaller particles that pose additional risks due to their enhanced bioavailability and potential for cellular penetration. Their tiny size enables them to bypass filtration systems, enter food and water supplies, and even become airborne. Inhalation, ingestion, and dermal exposure contribute to human bioaccumulation, raising concerns about their long-term impact on human health and the environment.

Studies confirm that microplastics have been detected in human feces, placentas, and organs such as the brain, lungs, and liver. Furthermore, plastics act as carriers for toxic chemicals, including endocrine-disrupting compounds, heavy metals, and persistent organic pollutants. These chemicals, including phthalates, bisphenol A (BPA), lead, and polycyclic aromatic hydrocarbons (PAHs), have been linked to severe health consequences such as hormonal imbalances, neurotoxicity, and carcinogenicity. Microplastics and nanoplastics have also been identified as vectors for environmental pollutants that further exacerbate toxicity risks in biological systems.

Regulatory efforts to control microplastic contamination vary across jurisdictions, but widespread standardization in analytical methods and mitigation strategies is urgently needed.

2. INTRODUCTION

Microplastics are defined as plastic particles smaller than 5 mm, while nanoplastics are particles smaller than 1 µm. They are found in virtually all environmental compartments, including marine and freshwater ecosystems, soil, air, and even inside living organisms (Peeken et al., 2018; Allen et al., 2019). The widespread presence of micro and nanoplastics is directly linked to the exponential increase in global plastic production, which has surged from approximately 1.5 million tons in 1950 to over 367 million tons in 2020. Their extreme mobility, and resistance to natural degradation make them a growing concern for both environmental and human health.

The small size of the plastic particles, coupled with the inherent chemical properties of the polymers, directly contributes to their extreme persistence in the environment. Unlike organic materials that degrade through microbial action, plastics are made from long-chain polymers that resist decomposition. The degradation process can take centuries, during which plastics fragment into smaller particles, eventually reaching nanometer scales. These particles disperse widely, affecting all biological systems from the deepest ocean trenches to the upper atmosphere (Table 1).

Table 1. Common Polymers with Degradation Times and Uses

Polymer Name	Abbr.	Chemical Formula	CAS Number	Common Uses	Degradation Time (Approx.)	Melting Point (°C)	Industries Involved
Polyethylene Terephthalate	PET	$(C_{10}H_8O_4)_n$	25038-59-9	Beverage bottles, food packaging	5-10 years	250	Packaging, Textiles
High-Density Polyethylene	HDPE	$(C_2H_4)_n$	9002-88-4	Milk jugs, detergent bottles, piping	10-20 years	130	Packaging, Construction
Polyvinyl Chloride	PVC	$(C_2H_3Cl)_n$	9002-86-2	Pipes, cable insulation, flooring	50-80 years	240	Construction, Electrical
Low-Density Polyethylene	LDPE	$(C_2H_4)_n$	9002-88-4	Plastic bags, film wrap, squeeze bottles	5-10 years	120	Packaging, Consumer Goods
Polypropylene	PP	$(C_3H_6)_n$	9003-07-0	Food containers, automotive parts, textiles	20-30 years	173	Packaging, Automotive, Textiles
Polystyrene	PS	$(C_8H_8)_n$	9003-53-6	Disposable cups, insulation materials, toys	50 years	240 (isotactic)	Packaging, Construction, Consumer Goods
Acrylonitrile Butadiene Styrene	ABS	$(C_8H_8C_4H_6C_3H_3N)_n$	9003-56-9	LEGO bricks, electronic housings, automotive parts	50-80 years	105	Toys, Electronics, Automotive
Polymethyl Methacrylate	PMMA	$(C_5O_2H_8)_n$	9011-14-7	Acrylic glass, lenses, screens	50-100 years	105	Optics, Construction, Automotive
Polycarbonate	PC	$(C_{16}H_{14}O_3)_n$	25037-45-0	Eyeglass lenses, CDs/ DVDs, water bottles	50-100 years	225	Electronics, Optics, Consumer Goods
Polyethylene	PE	$(C_2H_4)_n$	9002-88-4	Plastic bags, bottles, toys	5-10 years	115	Packaging, Consumer Goods
Polyamide (Nylon)	PA	$(C_6H_{11}NO)_n$	25038-54-4	Textiles, automotive parts, sports equipment	30-40 years	190-350	Textiles, Automotive, Industrial Applications
Polytetrafluoroethylene	PTFE	$(C_2F_4)_n$	9002-84-0	Non-stick coatings, gaskets, seals	500 years	327	Cookware, Chemical Processing, Aerospace
Polyurethane	PU	$(C_2H_7NO)_n$	9009-54-5	Foams, adhesives, coatings	20-30 years	180	Furniture, Construction, Automotive
Polyethylene Naphthalate	PEN	$(C_{12}H_8O_4)_n$	25053-79-0	Beverage bottles, electronic displays	5-10 years	270	Packaging, Electronics
Polybutylene Terephthalate	PBT	$(C_{12}H_{12}O_4)_n$	30965-26-5	Electrical connectors, automotive parts	10-20 years	223	Electronics, Automotive

Despite the wide variability of polymers in consumer use, the majority of micro and nanoplastic contamination are due to polymers like polyethylene, polyester, and plastics found in consumer goods (Table 2).

Table 2. Microplastic Burden by Type of Plastic

Plastic Type	Abbr.	Avg. Microplastic Contribution (Approx.)	Global Production (Million Metric Tons) (Approx.)	Common Sources
Polyester	PES	35.5%	55	Synthetic clothing, textiles, fishing nets
Polyethylene	PE	26%	100	Plastic bags, bottles, packaging
Polypropylene	PP	16.5%	75	Food containers, textiles, ropes
Polyamide	PA	16%	7	Nylon fabrics, fishing gear, industrial fibers
Polystyrene	PS	6%	25	Disposable cups, food packaging, insulation

The growing concern surrounding micro and nanoplastics has led to an increase in research and regulatory focus. Various international organizations and academic institutions have initiated studies to assess the environmental impact of these materials, their pathways into human consumption, and their potential long-term health effects. However, despite increasing awareness, effective mitigation strategies remain inconsistent across regions, highlighting the need for a unified approach.

3. SOURCES OF MICROPLASTICS

Microplastics originate from various sources and are classified as primary or secondary. Primary microplastics are intentionally manufactured at small sizes (e.g., microbeads in personal care products), and secondary microplastics are a result from the degradation of larger plastic debris.

Primary microplastics include industrial abrasives, synthetic beads, and microfibers shed from textiles. These materials are designed for commercial use in products such as exfoliating skin cleansers, synthetic fabrics, and even industrial blasting agents used in surface treatments. Despite their intentional manufacture, they contribute significantly to environmental contamination due to inadequate waste management practices.

Secondary microplastics result from the breakdown of larger plastic products due to UV radiation, mechanical stress, and chemical reactions. Packaging waste, single-use plastics, and improperly discarded consumer products degrade into microplastics over time. Tire wear particles, generated as vehicles travel on roads, contribute significantly to microplastic pollution, making roadways a major source of environmental contamination. Wastewater treatment plants serve as distribution hubs for microplastics, as many of these small particles are not effectively filtered during sewage processing, ultimately being discharged into waterways (Figure 1 - see next page).

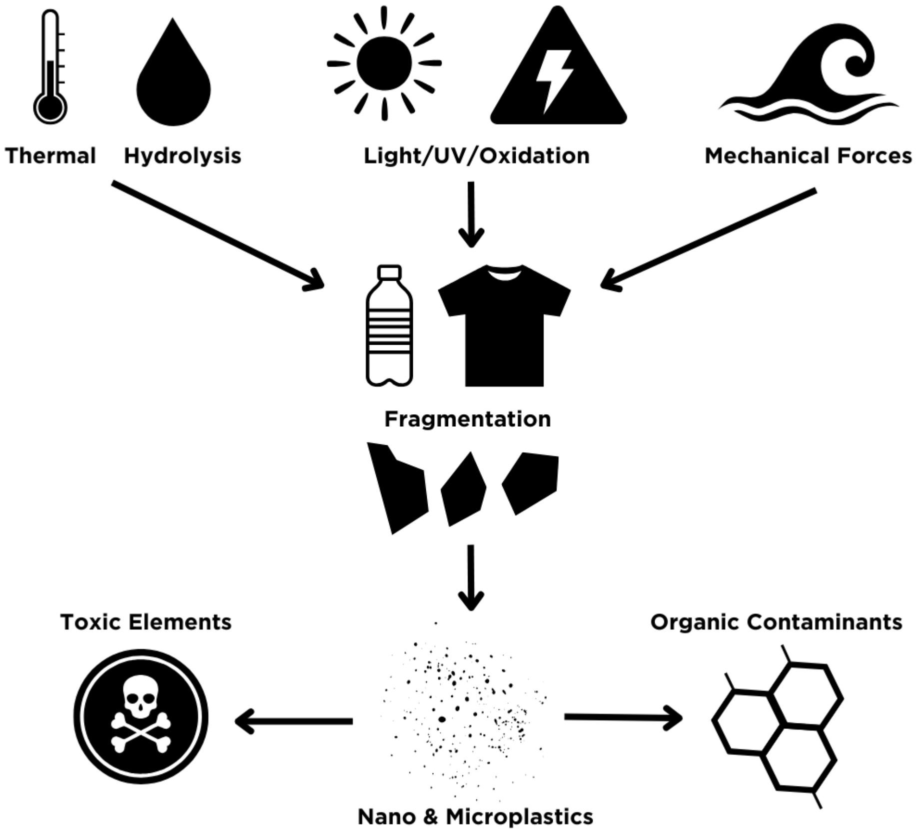

Figure 1. Processes Leading to Secondary Nano and Microplastics

The largest sources of micro and nanoplastic particles in the environment are textiles and tire wear. As shown in Figure 2, textiles represent a significant portion of microplastic pollution. This high contribution is primarily due to the shedding of microfibers from synthetic fabrics during washing and general wear. Synthetic textiles, such as polyester, nylon, and acrylic, are made from plastic polymers. When these fabrics are washed, the mechanical action and water flow cause tiny fibers to break off and enter wastewater systems. Additionally, the increasing consumption of fast fashion and the widespread use of synthetic textiles in clothing, home furnishings, and industrial applications further exacerbate this problem. Since textile sources are one of the major sources of microplastic contamination, it is not surprising that the main type of textile polymers, polyester, is a large contributor to microplastic pollution.

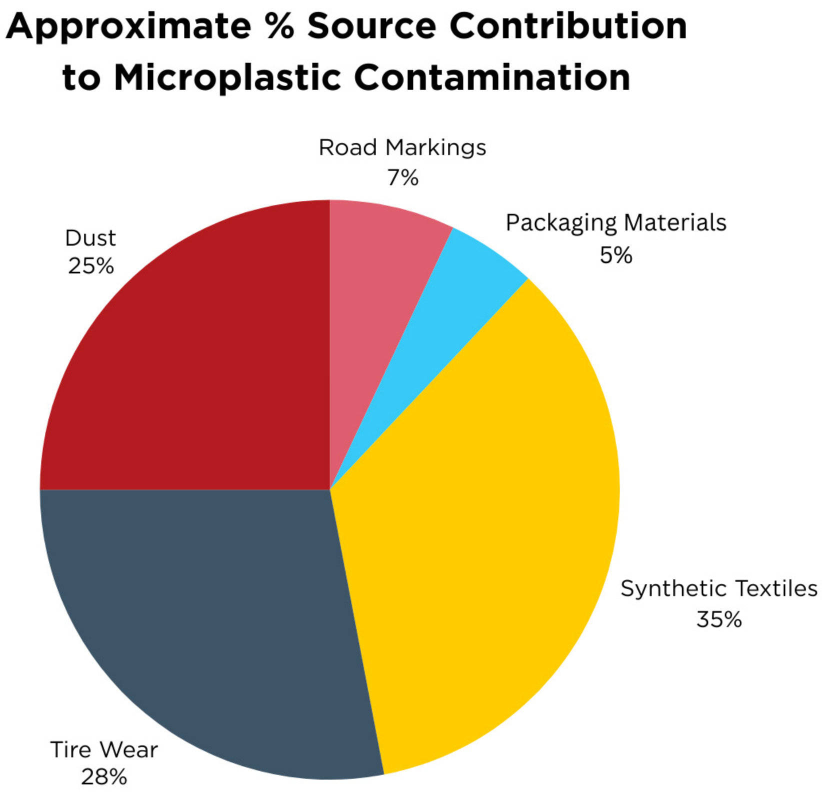

Figure 2. Illustrates the Approximate Apportionment of Microplastic Particles by their Largest Sources.

3.1. Accumulation in Food and Water Sources

Microplastics have been detected in a wide range of food and beverages, including bottled water, seafood, dairy products, salt, and fresh produce. Studies estimate that humans consume between 39,000 and 52,000 microplastic particles annually, increasing to 74,000–121,000 particles per year when inhalation is considered (Environmental Science & Technology, 2019). Bottled water alone contributes with 94 microplastic particles per liter, highlighting packaging as a major source of contamination (Statista, 2023). Additionally, microplastics in the atmosphere settle on food during processing and packaging, further increasing exposure. Table 3 summarizes detected microplastic concentrations in various products, highlighting the extent of contamination across different categories. These data underscore the ubiquitous nature of microplastics and the potential for ingestion through common consumption habits.

Table 3. Products with Cited Large Concentrations of Microplastics

Super Category	Food/Beverage Item	Detected Microplastics (Range per Liter/Kg)
Water	Bottled Water	50 - 325 particles/L
	Tap Water	5 - 100 particles/L
Beverages	Beer	10 - 80 particles/L
	Soft Drinks and Cold Tea	9 - 50 particles/L
	Milk	6 - 40 particles/L
	Wine	15 - 75 particles/L
	Tea Bags	10 - 60 particles/L
Pantry Goods	Salt	100 - 1,200 particles/Kg
	Sugar	50 - 300 particles/Kg
	Honey	60 - 500 particles/Kg
	Rice	50 - 250 particles/Kg
	Fruits and Vegetables	40 - 200 particles/Kg
	Eggs	30 - 150 particles/Kg
Processed Foods	Seafood (Fish and Shellfish)	150 - 600 particles/Kg
	Processed Meats	100 - 450 particles/Kg
	Canned Food	120 - 500 particles/Kg
	Tea	20 - 90 particles/Kg
	Coffee	30 - 100 particles/Kg
Other	Tire Wear Contaminated Food	Variable
	City Dust Contaminated Food	Variable
	Breast Milk	40 - 300 particles/Kg

Aquatic environments are particularly vulnerable to microplastic pollution, leading to significant accumulation in marine organisms. Seafood, a staple in many diets, can therefore serve as a substantial source of microplastic exposure. Table 4 presents cited microplastic concentrations found in various seafood species, demonstrating the bioaccumulation of these particles within the marine food web. Research has shown that marine organisms like fish and filter-feeders, such as mussels and oysters, contain high concentrations of microplastics, as they indiscriminately ingest suspended particles in the water.

Table 4. Seafood Types with Cited Microplastic Concentrations

Seafood Species		Detected Microplastics (Range per Sample)
Crustacean	Pink Shrimp	50 - 500 particles/sample
Mollusks	Mollusks (Clams, Mussels, Oysters, Scallops)	100 - 1,500 particles/sample
Fish	Pacific Herring	30 - 300 particles/sample
	Pacific Lamprey	20 - 250 particles/sample
	Black Rockfish	25 - 275 particles/sample
	Lingcod	15 - 200 particles/sample
	Chinook Salmon	5 - 150 particles/sample

Agricultural crops are also vulnerable to contamination, as microplastics present in irrigation water, biosolids, and atmospheric deposition are absorbed by plant root systems. This results in human exposure not only through direct food consumption, but also through trophic transfer as livestock feed on contaminated forage and grains.

3.2. Presence of Microplastics in Human Tissues & Health Impacts

Ultimately, the contamination of agricultural and food products continues up the food chain to accumulate in human bodies. It is estimated that every person on the planet has significantly measurable amounts of microplastics in their tissues (Dzierzynksi et al., 2024) (Leonard et al., 2024). A 2019 study detected a median of 20 microplastic particles per 10 grams of stool, confirming widespread ingestion (Schwabl et al., 2019). There have been studies of microplastic exposure to humans leading to microplastics passing through significant biological barriers like the blood-brain barrier and the placenta. Microplastics have been identified in both maternal and fetal placental tissues, indicating prenatal exposure (Ragusa et al., 2021). Plastics have been found in the brain, heart, liver, kidneys, lungs, and spleen, with concentrations reaching 7 grams per brain in some individuals (Leslie et al., 2022).

These microplastics and their chemicals can be significant sources of chemical exposure responsible for numerous conditions from endocrine disruption to other diseases. Phthalates and BPA (common plastic additives) interfere with hormone regulation, leading to metabolic disorders and reproductive health issues. Heavy metals and other toxic chemicals are known contaminants to cause neurotoxicity and carcinogenicity. Lead and styrene exposure from microplastics can result in cognitive impairments and developmental delays while certain plastic components, including PAHs and butadiene, are known carcinogens with long-term health implications.

The size of particles can become respiratory hazards causing inflammation and oxidative stress exacerbating conditions like asthma. In addition, minute diameter plastic particles have been increasingly detected in high-altitude clouds, suggesting they may play a role in air pollution and respiratory exposure (Mongabay, 2023).

4. REGULATORY FRAMEWORK AND POLICIES ON MICROPLASTICS

Regulatory agencies worldwide are taking steps to mitigate microplastic pollution, though there is significant variation in enforcement and scope. The European Union (EU) has led efforts through the REACH regulation, which restricts the use of intentionally added microplastics in consumer products. The Microplastics Restriction Proposal, published by the European Chemicals Agency (ECHA), aims to reduce microplastic emissions by over 500,000 metric tons within 20 years. Additionally, the Marine Strategy Framework Directive (MSFD) classifies microplastics as marine pollutants, requiring member states to take corrective action.

In the United States, the Microbead-Free Waters Act (2015) prohibits microbeads in rinse-off cosmetics, but broader legislation on secondary microplastics remains limited. The Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) continue to assess risks but have not yet set enforceable exposure limits. California, however, has introduced SB 54, a comprehensive plastic pollution reduction initiative, which mandates packaging recyclability targets and restricts single-use plastics.

China has imposed restrictions on microplastic use in cosmetics and food packaging, with additional bans on plastic waste imports to curb contamination. Other countries, including Canada, Australia, and Japan, have initiated microplastic monitoring programs and industrial restrictions, though enforcement varies. At the international level, the United Nations Environment Programme (UNEP) is negotiating a global plastic treaty aimed at reducing plastic waste production and improving waste management systems worldwide (Table 5 - see next page).

Table 5. Summary of Microplastics Regulations

Region	Regulation	Details	Enforcement Status
United States	Microbead-Free Waters Act of 2015	Bans the manufacture and sale of rinse-off cosmetics containing plastic microbeads	Fully enforced since 2017
Canada	Microbead Ban (2019)	Prohibits the sale and manufacture of toiletries containing microbeads	Fully enforced since 2019
South America	Argentina's Microbead Ban	Bans the production, import, and marketing of cosmetics with plastic microbeads	Fully enforced
Europe	Commission Regulation (EU) 2023/2055	Restricts the use of intentionally added microplastics in products	Regulation adopted, phased enforcement starting in 2025
China	14th Five-Year Plan for Plastic Pollution Control	Includes measures to reduce plastic waste and restrict non-degradable plastics	Ongoing implementation with varying degrees of enforcement
Japan	Osaka Blue Ocean Vision	Aims to reduce additional marine plastic litter pollution to zero by 2050	Long-term goal; voluntary commitments with gradual enforcement

5. METHODS FOR SAMPLING, PREPARATION, AND ANALYTICAL TESTING OF MICROPLASTICS

5.1. Sampling Techniques

The accurate detection and quantification of microplastics require rigorous sampling methods that account for different environmental matrices. Standardized protocols include:

- Water Sampling: Filtration through mesh sizes (e.g., 0.45 µm–5 mm) followed by density separation.
- Sediment and Soil Sampling: Extraction through elutriation, sieving, and digestion techniques to isolate microplastics from organic and mineral matter.
- Air Sampling: High-volume air samplers equipped with glass-fiber or polymer-based filters collect airborne microplastics for analysis.
- Food and Biological Tissue Sampling: Acidic or enzymatic digestion of organic matter allows microplastic isolation from foodstuffs, feces, and tissues.

Once collected, samples undergo preparation steps such as density separation (using solutions like NaCl, $ZnCl_2$, or NaI), oxidative digestion (using hydrogen peroxide or Fenton's reagent), and enzymatic treatments to break down organic material while preserving polymer integrity. Filtration through membrane filters (e.g., polycarbonate or cellulose) ensures microplastic isolation for downstream analysis.

5.2. Analytical Methods for Microplastic Detection and Identification

Several analytical tools allow for polymer identification and quantification in microplastic research. The most common methods include spectroscopic methods such as Fourier Transform Infrared Spectroscopy (FTIR) which is used for particles >20 µm and identifies polymers based on infrared absorption spectra. Raman Spectroscopy which is highly sensitive for small particles (<1 µm) but requires fluorescence suppression techniques. Scanning Electron Microscopy

(SEM) with Energy Dispersive X-ray Spectroscopy (EDS) that can provide high-resolution imaging and elemental composition analysis. Pyrolysis-Gas Chromatography-Mass Spectrometry (Py-GC-MS) which breaks down plastics into monomeric components for precise polymer identification and Thermal Extraction Desorption-GC-MS that is used for quantifying microplastic mass in complex matrices (Table 6).

Table 6. Methods of Microplastic Analysis

Technique	LOD (μm)	LOQ (μg)	Polymer Identification	Particle Size Determination	Pros	Cons
Stereomicroscopy	>50	NA	No	Yes	Simple, low cost	Cannot confirm polymer type, subjective analysis
Fluorescence Microscopy (Nile Red)	20	NA	No	Yes	Enhances contrast, useful for automation	False positives, no polymer ID
ATR-FTIR	500	10–50	Yes	No	Non-destructive	Limited to large particles
μ-FTIR	10	1–5	Yes	Yes	High resolution	Long analysis time
Raman Spectroscopy	1	1	Yes	Yes	Detects small particles, high specificity	Fluorescence interference
Py-GC/MS	NA	1–10	Yes	No	High sensitivity	Destructive, no size info
TED-GC/MS	NA	<1	Yes	No	Lower LOD than Py-GC/MS	Destructive, no size info
LC-MS	NA	ng range	No (only additives)	No	Detects plastic degradation products	Cannot detect intact plastics

5.3. Key Limitations Across Techniques

1. Inability to Identify Smallest Nanoplastics (<1 μm)

- Most techniques struggle to detect nanoplastics (<1 μm) due to optical diffraction limits.

- Only Raman Spectroscopy can detect down to ~1 μm

2. Distinguishing Polymer Types

- Microscopy-based techniques (e.g., stereomicroscopy, fluorescence microscopy) cannot determine polymer type.

- FTIR and Raman spectroscopy are required for polymer ID.

3. Distinguishing Between Aged and Fresh Plastics

- FTIR and Raman are limited in detecting degraded plastics, as oxidation and weathering change polymer spectra

- Py-GC/MS and TED-GC/MS are better for identifying degraded polymers.

4. Particle Shape & Size Determination

- Spectroscopic (FTIR, Raman) and thermal (Py-GC/MS) methods provide polymer ID but do not provide particle shape or size.

- Microscopy and SEM-EDS provide size and morphology but not polymer ID.

Each technique has its own uses and limitations. The best techniques for polymer identification or quantification are spectroscopy techniques such as Raman, FTIR, Py-GC/MS. The best technique for particle size and morphology are based on microscopy, such as SEM. Mixed or degraded plastic analysis is most often accomplished using Py-GC/MS, TED-GC/MS. Sometimes the method is determined by the type of sample. Low concentration samples need instruments with higher sensitivity (Table 7).

Table 7. Methods for Microplastic Analysis by Sample Type

Sample Type	Best Technique for Polymer ID	Best for Small Particles (<10 µm)	Best for Qualification
Drinking Water	µ-FTIR, Raman	Raman	TED-GC/MS
Bottled Water	µ-FTIR	Raman	TED-GC/MS
Salt, Sugar, Rice	µ-FTIR	Fluorescence Microscopy	Py-GC/MS
Seafood (Fish, Shellfish)	µ-FTIR	Raman	Py-GC/MS
Soft Drinks, Tea, Coffee	µ-FTIR	Raman	TED-GC/MS
Airborne Dust	FTIR, Raman	Raman	Py-GC/MS
Pharmaceuticals	Raman (SERS)	Raman	TED-GC/MS

5.4. Use of Reference Materials in Microplastic Testing

The reliability and comparability of microplastic research hinge upon the rigorous application of standardized methodologies and robust quality control (QC) procedures. At the core of these practices lies the indispensable use of reference materials (RMs) or certified reference materials (CRMs). Standardized RMs or CRMs are crucial for ensuring interlaboratory comparability, validating analytical methods, and maintaining stringent QC in microplastic testing. Without these materials, data inconsistencies and uncertainties can undermine the integrity of scientific findings and hinder effective regulatory efforts.

Chiron's MicroPRefs® standards (Figure 3) exemplify the importance of high-quality reference materials. These standards are available in both neat powder form and in soda tablets. They provide well-characterized microplastic particles across various polymer types, including PE, PP, PS, PET, PVC, and PC, with particle size ranging from 50 µm to 300 µm and irregular shape that mimic microplastics found in environmental samples. (For additional product information refer to the Appendix).

The neat MP reference materials are primarily intended for MP analysis using thermoanalytical methods such as Pyrolysis GC-MS or TED-GC/MS. The soda tablets are designed for vibrational spectroscopy and microscopy techniques, including µ-FT-IR and µ-Raman.

Building upon significant research on reference materials for micro- and nano-plastics, Chiron, together with the Norwegian Institute of Water Research (NIVA), has pioneered a unique concept for producing reference materials for microplastics in the size range of 50-300 µm. This innovative approach utilizes cryo-milling and the incorporation of microplastics into soda tablets. These tablets offer significant advantages, including ease of shipping and straightforward laboratory use for method development and quality control, which are essential for analytical methods used to monitor microplastics and nanoplastics.

By utilizing these RMs, laboratories can establish consistent analytical procedures, ensuring that results are reproducible and comparable across different studies and institutions. This consistency is particularly vital in regulatory studies, where accurate cross-comparisons are essential for informed decision-making.

MicroPRefs® Tablets

- Specific number of particles
- For virational spectroscopy (FTIR, LDIR, Raman) and microscopy

MicroPRefs® Neat

- For thermoanalytical methods such as Pyrolysis GC-MS or TED-GC/MS

MicroPRef® Type	Characteristics	# of Particles	Particle Size	Parameter	Technique(s)
NEAT	Neat microplastics	-	50-300 µm	Polymer Identification Purity	Pyrolysis-GC/MS
TABLET	Microplastics mixed with excipient	50–70 particles	50-300 µm	Number of particles Polymer identification	Optical Microscope µ-FTIR, µ-Raman, LDIR

Figure 3. Chiron's MicroPRefs® Reference Materials

The development of novel reference materials, such as microplastic standards, has improved detection accuracy. Studies show that RMs enable reliable calibration curves, accurate recovery rate assessments, and effective contamination control in microplastic studies (Martínez-Francés et al., 2023). The soda tablet concept (Figure 4) facilitates the production of environmentally appropriate RM/CRMs at relevant concentrations, both on a mass basis and in terms of particle numbers.

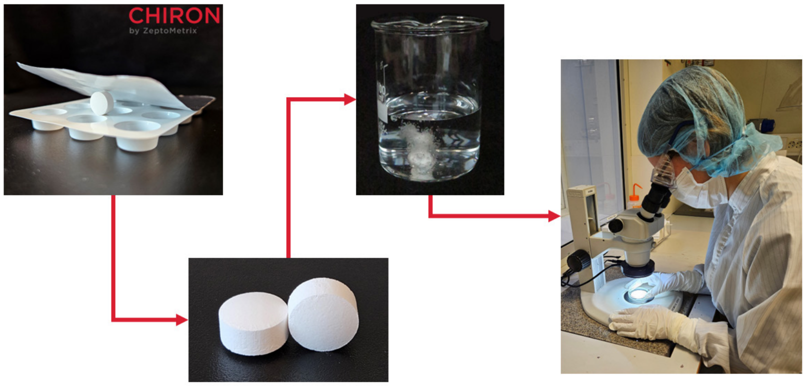

Figure 4. Concept of Using MicroPRefs® Soda Tablets

6. CONCLUSION

Microplastics and nanoplastics are among the most significant emerging pollutants, with widespread implications for environmental sustainability and human health. Their persistence, combined with the complexity of detecting and regulating them, makes mitigation challenging, but an urgent priority. Enhanced regulatory frameworks, standardized analytical methods, and the development of high-quality reference materials are necessary for improving detection accuracy and implementing effective risk management strategies.

Future research must focus on advancing detection technologies, refining exposure risk assessments, and developing scalable solutions for plastic waste reduction. Collaboration between industry, policymakers, and the scientific community is essential in addressing the long-term consequences of microplastic pollution.

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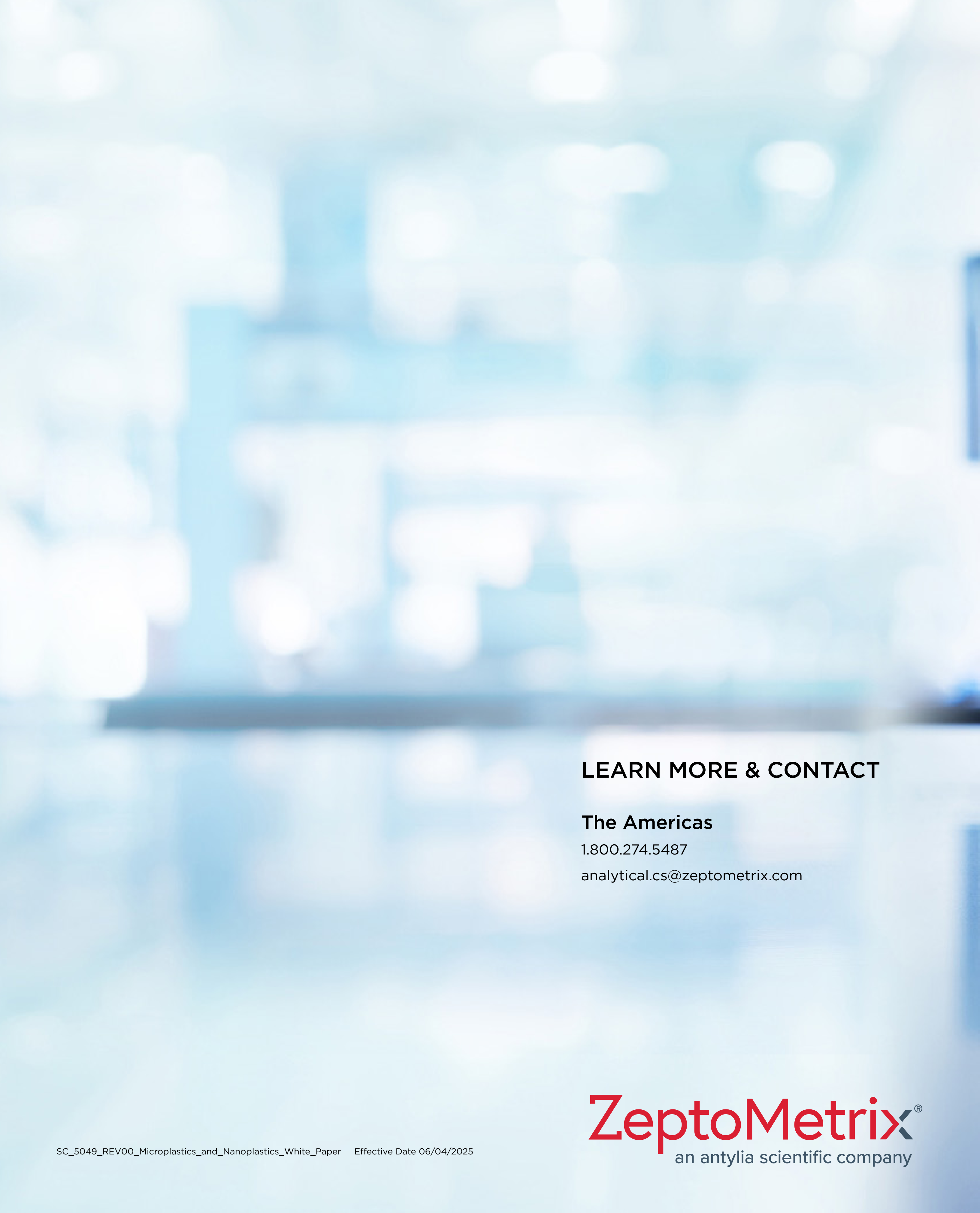
8. APPENDIX

Part No.	Chiron Part No.	Description	No. of Particles	Particle Size	Unit of Measure	Units/ Pack	Matrix
24121-65	15459.X-TAB	MicroPRefs® Blank tablet	-	-	EA	1	tablet
24121-66	15459.X-TABx3	MicroPRefs® Blank tablets (3/PK)	-	-	PK	3	tablet
24121-68	15246.X-50/300-TAB	MicroPRefs® Polyethylene tablet	50-70 particles	50-300 µm	EA	1	tablet
24121-69	15246.X-50/300-TABx3	MicroPRefs® Polyethylene tablets (3/PK)	50-70 particles	50-300 µm	PK	3	tablet
24121-71	15247.X-50/300-TAB	MicroPRefs® Polyethylene terephthalate tablet	50-70 particles	50-300 µm	EA	1	tablet
24121-72	15247.X-50/300-TABx3	MicroPRefs® Polyethylene terephthalate tablets (3/PK)	50-70 particles	50-300 µm	PK	3	tablet
24121-74	15248.X-50/300-TAB	MicroPRefs® Polystyrene tablet	50-70 particles	50-300 µm	EA	1	tablet
24121-75	15248.X-50/300-TABx3	MicroPRefs® Polystyrene tablets (3/PK)	50-70 particles	50-300 µm	PK	3	tablet
24121-77	15249.X-50/300-TAB	MicroPRefs® Polypropylene tablet	50-70 particles	50-300 µm	EA	1	tablet
24121-78	15249.X-50/300-TABx3	MicroPRefs® Polypropylene tablets (3/PK)	50-70 particles	50-300 µm	PK	3	tablet
24121-80	15250.X-50/300-TAB	MicroPRefs® Polyvinylchloride tablet	50-70 particles	50-300 µm	EA	1	tablet
24121-81	15250.X-50/300-TABx3	MicroPRefs® Polyvinylchloride tablets (3/PK)	50-70 particles	50-300 µm	PK	3	tablet
24121-83	15251.X-50/300-TAB	MicroPRefs® Polycarbonate tablet	50-70 particles	50-300 µm	EA	1	tablet
24121-84	15251.X-50/300-TABx3	MicroPRefs® Polycarbonate tablets (3/PK)	50-70 particles	50-300 µm	PK	3	tablet
24121-86	S-5401-50/300-TAB	MicroPRefs® Tablet: Mix of PE, PET, PS	70-100 particles	50-300 µm	EA	1	tablet
24121-87	S-5401-50/300-TABx3	MicroPRefs® Tablets: Mix of PE, PET, PS (3/PK)	70-100 particles	50-300 µm	PK	3	tablet
24121-89	S-5402-50/300-TAB	MicroPRefs® Tablet: Mix of PP, PVC, PC	70-100 particles	50-300 µm	EA	1	tablet
24121-90	S-5402-50/300-TABx3	MicroPRefs® Tablets: Mix of PP, PVC, PC (3/PK)	70-100 particles	50-300 µm	PK	3	tablet

8. APPENDIX (CONTINUED)

Part No.	Chiron Part No.	Description	Particle Size	Unit of Measure	Units/ Pack	Matrix
24121-92	15246.X-1MG	MicroPRefs® Polyethylene	50-300 µm	EA	1	neat
24121-93	15247.X-1MG	MicroPRefs® Polyethylene terephthalate	50-300 µm	EA	1	neat
24121-94	15248.X-1MG	MicroPRefs® Polystyrene	50-300 µm	EA	1	neat
24121-95	15249.X-1MG	MicroPRefs® Polypropylene	50-300 µm	EA	1	neat
24121-96	15250.X-1MG	MicroPRefs® Polyvinylchloride	50-300 µm	EA	1	neat
24121-97	15251.X-1MG	MicroPRefs® Polycarbonate	50-300 µm	EA	1	neat
24121-98	15558.6-KIT-1MG	MicroPRefs® PE, PET, PS, PP, PVC, & PC Kit	50-300 µm	KIT	6	neat



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