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SAMPLING AND REAL-TIME MONITORING

OF MICRO- AND NANOPLASTICS IN THE AIR

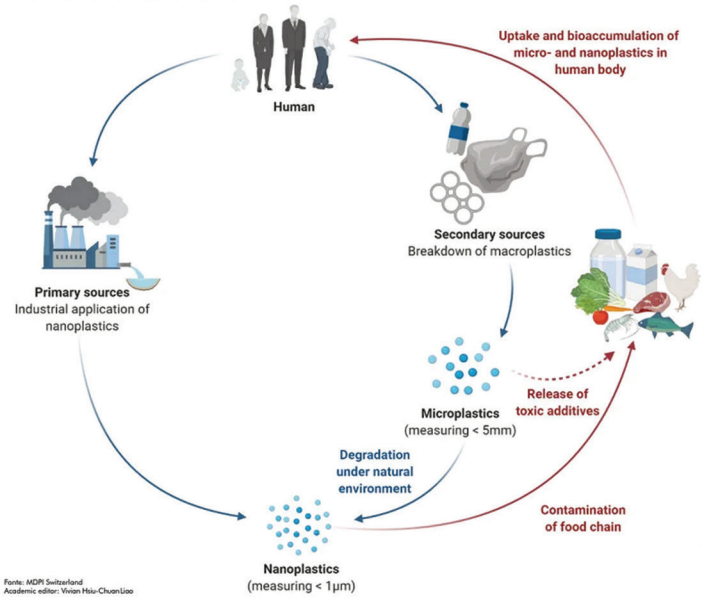
Microplastics and nanoplastics (MNPs) are **polymer particles** with dimensions ranging from 5 mm down to <100 nm, with a more recent classification distinguishing **microplastics (1 µm–5 mm)** from **nanoplastics (<1 µm)**.

In the atmospheric environment, the presence of MNPs has been documented globally. In indoor settings, concentrations of up to approximately 16.2 particles/m³ (NMP/m³) have been measured, with an **estimated inhalation rate of about 11.3 particles per hour**.

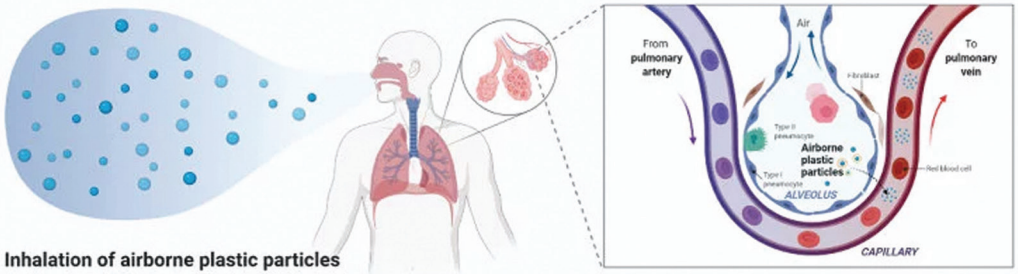
On a daily basis, this may correspond to a **potential exposure of up to ~272 particles inhaled over 24 hours** under light activity conditions.

Although these values vary depending on the environment and measurement methods, they highlight the relevance of inhalation exposure.

SOURCES AND FATE of Micro- and Nanoplastics in the Environment



INHALATION OF AIRBORNE PLASTIC PARTICLES



Inhalation of airborne plastic particles

- Indoor from synthetic textiles
- Outdoor from contaminated aerosol from ocean waves, airborn fertilizer particles from drief wastewater treatments, or atmospheric fallout

Factors that affect the absorption of plastic particles in the lungs:

- Hydrophobicity
- Surface charge
- Surface functionalization
- Surrounding protein coronas
- Particle size

References: Yee et al., Nanomaterials 2021, 11(2), 496

From a toxicological perspective, beyond potential physical effects on the respiratory system, **microplastics (MPs) may act as carriers for adsorbed chemical substances and pathogenic microorganisms. Nanoplastics (NPs), due to their submicrometric size, are of particular concern for their potential ability to interact with biological tissues.**

One of the main scientific challenges remains the **lack of standardized methodologies for sampling and analysis**, which limits data comparability and the definition of robust exposure scenarios, particularly in the atmospheric compartment.

XEarPro offers a range of solutions tailored to specific requirements and applications.

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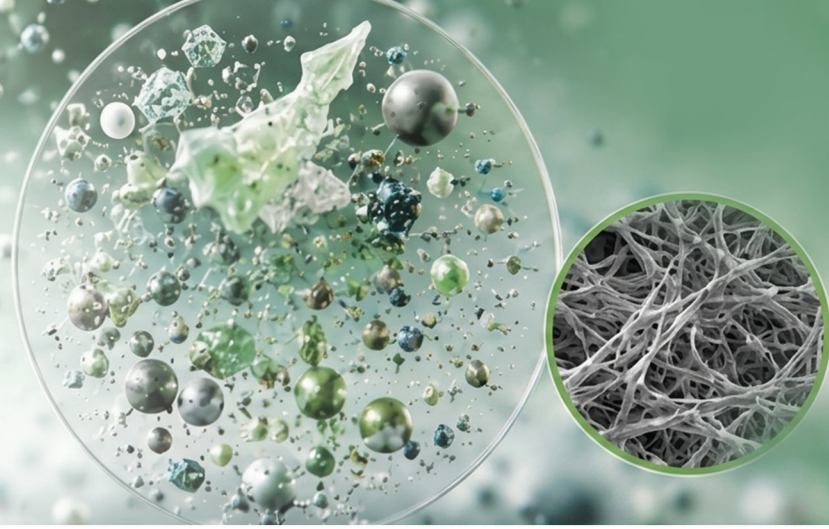


Sampling MNPs in real-world indoor and outdoor environments is challenging due to the **heterogeneous nature of airborne particles** and their **wide range of sizes and compositions**.

Additional challenges arise from the **lack of standardized methods** for their collection and identification.

SAMPLING
Active sampling for airborne MNPs and subsequent lab analysis

LAB ANALYSIS
Characterization in an advanced laboratory

REAL TIME DETECTION
Identification and counting of individual particles

SIZE RANGE FROM NANO TO MICRO
From a few nanometers up to hundreds of µm

LACK OF STANDARDIZED METHODS
Absence of shared reference methodologies

ENVIRONMENTAL AND HEALTH IMPACT
Need for reliable and continuous monitoring

XEarPro: One Challenge. Multiple Solutions.

1 FILTER/MEMBRANE SAMPLING

Collection of MPs on filters or membranes for laboratory analysis.

Flexible sampling configurations with different flow rates and filters (e.g., quartz or glass microfiber, cellulose ester membrane, PTFE, alumina, silver).

Compatible with major MNPs analytical techniques (SEM, FTIR/µFTIR, Raman/µRaman, Py-GC/MS, and more).

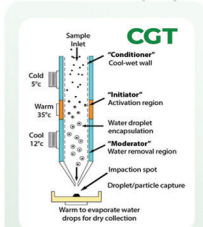
Low-Volume Samplers (2-20 L/min)

Medium-volume samplers (10–50 L/min)

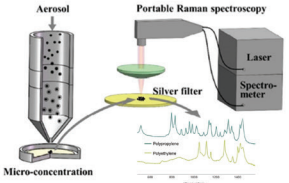
High-volume samplers (50–1000 L/min)

2 HIGH-EFFICIENCY INNOVATIVE SAMPLING

High-efficiency sampling of airborne nanoparticles (NPs).



- 90% collection efficiency for particles down to 5 nm.
- Sampling on impact surfaces or in liquid media.
- Direct MNP characterization.
- Suitable for near-real-time monitoring.



Collection onto dry surface
(i.e. 25 mm SEM stub) ready to interface with spectroscopic/microscopic techniques.

References: adapted from Zheng et al., Analytical Chemistry 2018, 90, 10, 6229-6239

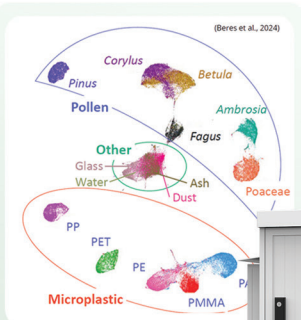
3 HIGH-RESOLUTION REAL-TIME MONITORING

Real-time monitoring of individual airborne microplastic particles (MPs).

4-IN-1 TECHNOLOGY

Light scattering
+ Holographic imaging
+ Depolarization
+ Fluorescence

Single-particle analysis and identification of airborne particles in the 0.3–300 µm size range.



References:
Beres, et al., Atmos. Meas Tech (2024)

INDOOR OUTDOOR REMOTE SITES