Microplastics in Drinking Water

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Introduction

The analysis of microplastics (MPs) in drinking water is transitioning from a research topic to a routine analytical task. As regulatory frameworks continue to evolve, standardized monitoring programs are expected to substantially increase the number of drinking water samples requiring analysis. This shift places new demands on analytical laboratories, which must combine reliable polymer identification with the throughput required for routine, large-scale monitoring.

The LUMOS II ILIM, combined with the ParticlePlus™ workflow, addresses this challenge by enabling the analysis of complete 25 mm filters with total turnaround times of less than 30 minutes per sample. Automated data acquisition and AI-driven polymer classification deliver reproducible and operator-independent microplastic analysis suitable for routine laboratory workflows.
This application note demonstrates the analysis of a drinking water sample collected in Hungary.

Experimental

The ParticlePlus™ workflow is designed for IR Laser Imaging (ILIM) microscopes. For this study, we employed the following setup:

- **Sample Details:** A 20 L raw drinking water sample collected in Hungary was filtered through a 25 mm Whatman® aluminum oxide filter (0.2 µm pore size) and kindly provided by Eurofins Analytical Services Hungary Kft.
- **Measurement Setup:** The LUMOS II ILIM in transmission mode and the software workflow ParticlePlus™ were used to perform automated whole filter imaging. Laser wavenumber was tuned with a spectral step size of 4 cm^{-1} across the MIR fingerprint region of 1800-1250 cm^{-1}.
- **Data Analysis Tool:** Following data acquisition, the hyperspectral data was automatically processed and analyzed by Bruker's Microplastic Identifier (MPID), requiring no user input. The identification threshold value was set to 750.

Results

The post-filtration instrument-to-result time for the complete 25 mm filter was 17 minutes: 12 minutes for full-filter acquisition of 22.5 million IR spectra and 5 minutes for automated processing. MPID performed fully automated microplastic analysis using machine-learning (ML) models for unsupervised particle detection and classification, as well as for determining particle-specific parameters such as size, morphology, and spatial distribution (further details about MPID are provided in the Product Note M210).

A total of 71 particles were detected and identified, comprising 59 polymer particles and 12 calcium carbonate ($CaCO_3$) particles, demonstrating the ability to distinguish polymeric from inorganic particles. Polyethylene (PE) was the most abundant polymer with 21 particles (36% of all polymers), followed by polypropylene (PP, 11), polyethylene terephthalate (PET, 9), polyamide (PA, 7) and polymethyl methacrylate (PMMA, 1). Based on the analyzed sample volume, this corresponds to a microplastic concentration of 2.9 MPs per liter.

The particle size distribution ranged from 8 µm to 83 µm with the largest number of particles (43%) falling in the 20 to 50 µm size range. This distribution is consistent with the commonly reported size range for environmental microplastics in drinking water.

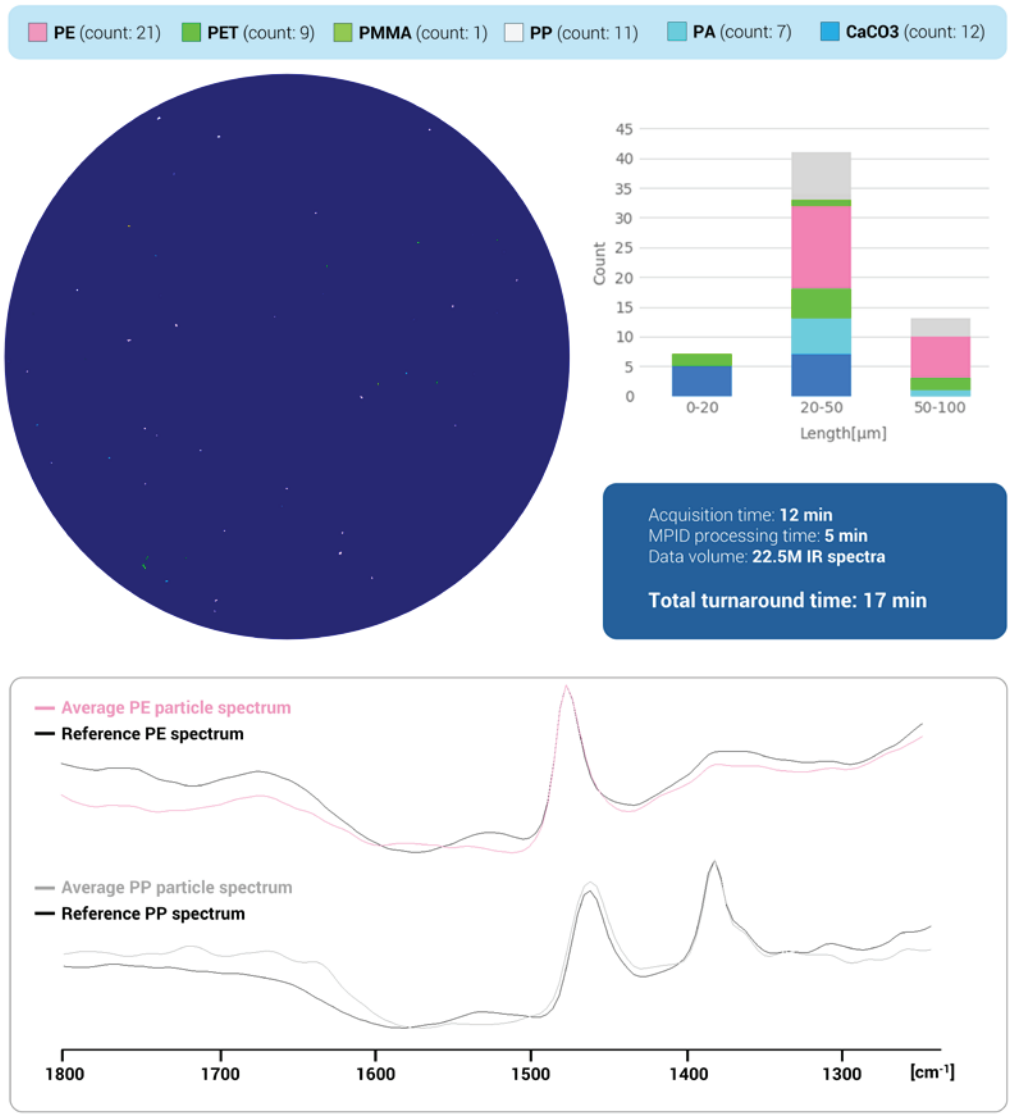


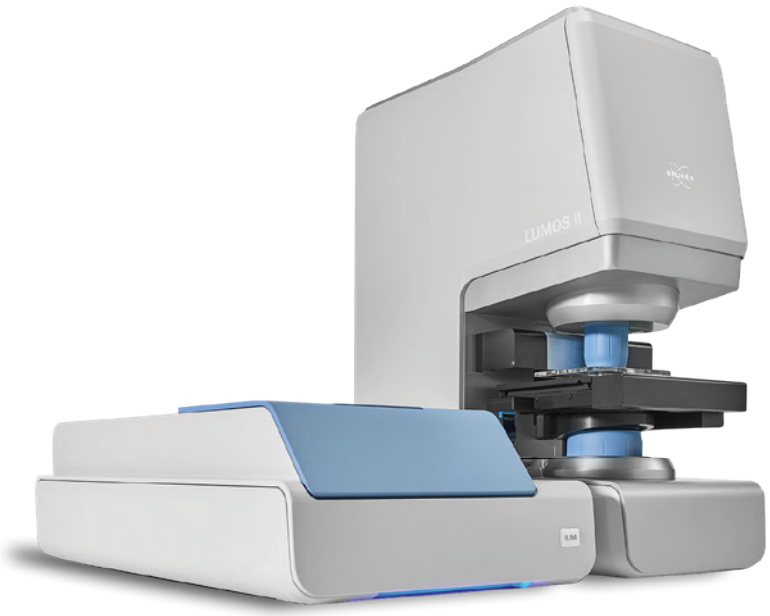
Fig. 1
Comprehensive results summary for the drinking water sample.

The quality of the unsupervised polymer classification is illustrated by comparing the average spectra of detected PE and PP particles (the two most abundant polymer classes) with their corresponding library reference spectra. The excellent spectral agreement confirms the robustness of the AI-driven identification and demonstrates that reliable polymer identification can be achieved despite the short turnaround time.

Conclusion

- A total turnaround time of <30 min per 25 mm filter allows high-throughput routine analysis.
- MPID delivers reliable results through unsupervised, AI-driven particle detection and classification, without requiring manual spectral evaluation.
- Simultaneous determination of polymer type, particle size, morphology, and spatial distribution provides comprehensive characterization for every particle.
- The LUMOS II ILIM in combination with ParticlePlus™ is the ideal solution for large-scale drinking water monitoring.

The Fastest IR Microscope Ever Built: LUMOS II ILIM



MEET THE LUMOS II ILIM

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