

## Advantages and limitations of spectroscopic and microscopic approaches for the characterisation of microplastics

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One of the key issues highlighted by the Marine Strategy Framework Directive Technical Subgroup on Marine Litter, in the document "Guidance on Monitoring of Marine Litter in European Seas" (2013),<sup>1</sup> is the lack of standardised methodologies and appropriate reference materials to determine the levels and state of anthropogenic plastic litter in aquatic environments.

Up to date, the quantification of microplastic particles in the environment has revealed mixed results ranging from stable to increasing concentrations.<sup>2</sup> It needs to be noted that robust and consistent methodology is only starting to emerge.<sup>3</sup> Despite the potential adverse impacts of microplastics on both aquatic biota and human health, the methodology for analysing microplastics in environmental samples is still lacking in precision. Moreover, no standard operating protocol currently exists for the detection of these pollutants.<sup>3</sup>

The majority of the studies for isolating microplastics from marine water and sediments cover a wide range of protocols including density separation,<sup>3-4</sup> elutriation,<sup>4-6</sup> or the use of acids, alkalis, hydrogen peroxide and enzymatic digestion.<sup>6-8</sup> Once the microplastics have been properly isolated, they can be analysed for quantification and/or identification using a range of spectroscopic or microscopic techniques. However, it is difficult to quantify and identify microplastics from complex air and water samples with a single analytical method.

This talk will discuss and summarise the main advantages and disadvantages offered by different spectroscopic and microscopic techniques for the characterisation of microplastics, including visual sorting,<sup>3, 9-10</sup> Scanning Electron Microscopy (SEM),<sup>11-12</sup> Pyrolysis-GC-MS,<sup>12</sup> Fourier Transformed Infrared Spectroscopy (FTIR)<sup>13-15</sup> and Raman spectroscopy.<sup>16</sup> The correct approach and the choose of the most appropriate technique is normally driven by the question we are asking. A combination of multiple methods is sometimes recommended when both quantification and identification are required. Promising emerging approaches for a faster characterisation, such as the use of fluorescent dyes, or specialised methods for studying biodegradation of plastics, such as Secondary Ion Mass Spectrometry (SIMS), will also be discussed.

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