Quantification of microplastics identified by micro-FTIR in sediments: Measurement uncertainty evaluation

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Abstract

The pollution of aquatic systems by plastic particles smaller than 5 mm – microplastics – is real and very debated by the scientific community, political bodies, and general society. The presence of microplastics can be monitored in different matrices such as sediment, water and biota. Samples from oceans, seas, rivers, lakes, estuarine areas and polar areas have been analysed. Several studies have been carried out worldwide over the years, where the physical-chemical characteristics of microplastics is included. However, most of these studies cannot be compared since the uncertainty associated with results is not reported.
The measurement uncertainty expresses the quality of a quantification, allowing its objective interpretation and to evaluate its fitness for purpose. The evaluation of the measurement uncertainty consists of a statistical and metrological treatment of the measurement process, involving the quantification and combination of the uncertainty sources from random and systematic effects.

This work presents the first bottom-up evaluation of the uncertainty of microplastics contamination quantification in sediments applied to the monitoring of four Portuguese inland waters (1). Sediment samples are first subjected to a proper pretreatment that involves the digestion of the sediment fraction lower than 5 mm, a density separation, a visual analysis, and a chemical identification by infrared spectroscopy (micro-FTIR). The evaluation of the measurement uncertainty involved using, among others, the Poisson-Lognormal distribution to model the particles counting component. The Monte Carlo Method was used to combine the uncertainty components identified.

Results demonstrated the ubiquitous presence of microplastics in all studied inland waters (2), reaching up to 969 microplastics per kg-1 associated with an uncertainty interval of (361; 2932) kg-1, where several samples had metrological different contamination for 99% confidence level.
This work represents a relevant contribution to improving the quality of the analyses of microplastics in environmental samples and to achievable harmonization of analytical protocols.

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