Analysis of Synthetic Micro and Nano Particles and Chemical Contaminants using Organic and Inorganic Nanofiltration Membranes

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Abstract:

The full implications associated to the release of microplastics (MPs) and nanoplastics (NPs) onto the environment and the possible threat to public health are only now being investigated, with no standardised adopted method yet to detect and quantify them. It is challenging to detect micropollutants smaller than 50-100 μm with current methods.

Thermogravimetric analysis (TGA) and pyrolysis (Py) techniques have been applied to the identification of MPs in water samples from environment combined with GC-MS analyses. However, MNPs are found in low concentrations in aqueous environmental samples, and it would require large sample volumes or continuous filtration to be pre concentrated and attain fractions large enough to be analysed via TGA and Pyrolysis. In our work we have overcome this issue by simply filtering the water samples with organic and inorganic nanofiltration membranes and analysed the plastic loaded membranes with pyrolysis-GC-MS. The analysis gave us the data for both membrane and retained plastics and only retained plastics, when organic and inorganic membranes were used, respectively. We then compared the GC-MS data with pure plastic samples and identified plastics retained by the membrane.

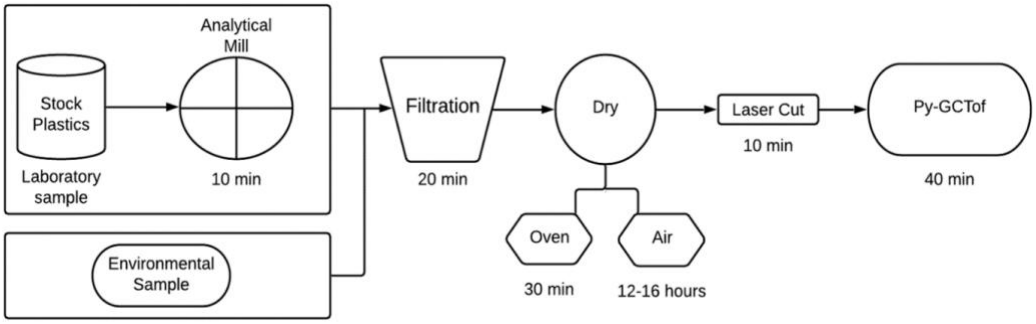

Figure 1. Illustrating the novel standard methodology proposed in this study for the identification of micro and nanoplastics in both laboratory and real environmental samples.

The deposition and analysis of MPs and NPs on organic and inorganic membranes (pore size 20-100 nm) has proven to be a robust and reliable method for the identification of submicron particles. MPs and NPs can be identified in complex aqueous samples at concentrations as low as 50 parts per billion. Membranes used in this research are commercially available, broadly used, inexpensive, and considerably thermal resistant, which allows this technique to be easily applied without time-consuming procedures and with sample volumes under 500 ml. The membranes supporting the micropollutants can be prepared in under an hour. The use of specific differential markers ions for plastics allows the determination of PS, PP and PVC even when present in a mixture. Finally, this method is suitable for the analysis of complex matrix

samples, and it was possible to identify PS on a membrane filtered with water obtained from a local river [1].

This method was also used to evaluate the impact of disposable and surgical face masks (DPFs) on water cycle by looking at the nano size particles leaching/detachment from these masks [2][3]. These studies focused on the emission of different contaminants from 12 DPFs brands (a total of 15 batches) that were immersed in deionised water in order to emulate environmental conditions once these DPFs are discarded and released into the environment. These DPFs were purchased from several manufacturers and suppliers and pollutants were filtered and deposited in membranes.

Keywords: Nanoplastics, Advanced analyses, Organic Nanofiltration, Inorganic Nanofiltration, Disposable Face Masks

References:

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