Preparation and test of a reference mixture of eleven polymers with deactivated inorganic diluent for microplastics analysis by pyrolysis-GC–MS

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Abstract:

Analytical pyrolysis coupled to gas chromatography and mass spectrometry (Py-GC–MS) can provide both qualitative and quantitative data on polymer mixtures, but no standardized protocols are available yet for the application of this technique in the field of environmental microplastics analysis. In this paper, we describe the preparation of a mixture of eleven common polymers, that could be used as reference sample for microplastics analysis in environmental samples by Py-GC–MS. The mixture is obtained combining two solutions with a total of nine polymers, and a solid mixture of two polymers with an inorganic diluent. First, a set of characteristic pyrolysis products and m/z signals is proposed as markers to perform semi-quantitative calculations. Then, changes in the pyrolytic yields of characteristic products due to secondary reactions in the pyrolytic environment are systematically evaluated. The characteristic pyrolysis product of polyurethane (PU), 4,4'-diphenylmethane diisocyanate (MDI), was found to be highly susceptible to hydrolysis by the inorganic diluent, except when deactivated silica was used. Finally, the performance of the reference mixture using the silica diluent is evaluated in terms of reproducibility and linearity of response. Relative standard deviations lower than 10% and good linearity of the integrated areas ($r^2 > 0.96$) were obtained for all polymers except PU and polyethylene terephthalate. The results show that the proposed mixture could be used in Py-GC–MS analyses of microplastics as a reliable reference material for at least nine of the eleven investigated polymers.

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Frontier Labs Products used:

Multi-Shot Pyrolyzer (EGA/PY-3030D), UA+-5, UA+-50