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IDENTIFICATION OF MICROPLASTICS IN DIFFERENT MIXTURES AND BLENDS THROUGH PYROLYSIS-GAS CHROMATOGRAPHY/MASS SPECTROSCOPY

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Abstract

The characterization of plastic in soils and waters is key to understand its environmental impact and both destructive and non-destructive methods are being used for this purpose. Molecular spectroscopy technologies, as Fourier transform infrared spectroscopy (FTIR) and Raman spectroscopy, show promising results in identifying qualitatively different microplastics simultaneously, but the former suffers from spatial resolution [1] and the latter from background noise and organic matter [2], even though they do not damage the sample. Among destructive techniques, differential scanning calorimetry (DSC) allow to identify not only qualitatively, but also quantitatively different polymers; however, it exhibits some limits with multicomponent mixtures [3].
Pyrolysis-gas chromatography/mass spectroscopy is able to identify single polymers in blends and mixtures. The aim of this work is to investigate the likelihood of detecting qualitatively single polymers in mixtures of few milligrams, in particular polyethylene (PE), polypropylene (PP), polyamide (PA), polycarbonate (PC) and polystyrene (PS) and quantitatively blends of PE, PP and PS with varying weight percentages of the individual constituents from 10 up to 90, that have undergone compounding process.
The results show the possibility of detecting the main characteristic products of PE, PP, PS, PC and PA in mixtures, as well as in PE-PP, PP-PS and PE-PS blends, after choosing their main peaks so as to avoid overlapping between them. Signal-to-noise (S/N) ratio is always greater than 3, which validate their identification [4].
Moreover, the quantification of PP in blends is always achieved and its trend can be considered as linear with R^2 higher than 0.9 when considering the variation of the peak area of its characteristic pyrolysis product as a function of its percentage weight change. Regarding PS and PE in blends, it has been possible to quantify them only from 30%wt, since the ratio between signal and noise with 10%wt of these polymers is lower than 10, which represents the limit of quantification (LOQ) [4].

References

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