

Quantification of organic plastic additives in plastics with (TD) Py-GC-HRMS

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Plastics were revolutionary inventions that symbolized globalization and the interconnection of economies between countries in the second half of the 20th and the early of the 21st centuries. They are widely used in various industrial sectors including food packaging, construction, automotive, electronics, textiles, household items, and toys, with the current global production reaching over 370 million tons per year. These synthetic materials are made of an organic polymer matrix and chemical additives. In total, more than 10 000 additives were identified in plastics and over 2 400 are considered as substances of potential concern as they meet one or more of toxicity criteria in the European Union (toxicity for reproduction, bioaccumulation,...). These substances may leached during the plastic life cycle (to foodstuff, environment, etc), resulting in potential human exposure.

Thus, the development of analytical methods capable of identifying and quantifying additives in plastics is necessary. It has been demonstrated that the thermal desorption method using a Pyrolysis coupled to GC-HRMS system can be a useful analytical tool for the rapid quantification of additives in polymer samples but method still need to be developed. For this study, additives of interest were first selected based on two main criteria: their toxicity according to the European Chemicals Agency and their migration limits set by EU Regulation No 10/2011. In total, 13 additives were selected (5 plasticizers, 6 flame retardants and 2 UV stabilizers).

Then, a reflection was set up in order to consider how to evaluate the response function of additives in the context of solid-state sample direct analysis. It was chosen to develop reference material incorporating additives into a polymer matrix at specified concentration levels, to produce plastic films, using masterbatch. This process is aimed to ensure homogeneous dispersion of the additives in the polymer matrix.

Finally, some preliminary analytical developments were carried out in order to perform future analyses, like acquisition of additives HRMS spectra, MS/MS patterns to select the optimum collision energies for each characteristic ion and the most abundant fragment resulting from fragmentation. A first application on solid-state plastic will be proposed.

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