**Analysis of microplastic in environmental samples using thermal analytical methodes**

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The most common way to identify MP particles in environmental samples is visual microscopy, as well as Fourier Transform Infrared Spectroscopy (FTIR) or Raman spectroscopy, that are often used as imaging microscopy. These spectroscopic methods work well due to the characteristic absorption spectra of the covalent bonds in the polymer molecules and with a high certainty.

However, limitations are set for FTIR spectra by overlapping analytical signals with compounds from the environmental matrix, so a pre-selection of polymeric particles is needed. Raman spectroscopy is limited to intrinsic fluorescence either from degraded polymer material and/or matrix compounds. Besides that, both methods are very time consuming, are expensive in purchase and need a high-qualified user. For confocal Raman imaging the three-dimensional selectivity proves to be very disadvantageous due to high curvature of the particles. Both methods are very time consuming, they need a high-qualified user and they are very expensive in purchase.

Well-known techniques in polymer characterization are the methods of thermal analysis. In thermal analysis, polymer characterization is done by temperature treatment and the polymer behavior depends on temperature. In the case of MP characterization, the thermogravimetry analysis (TGA) offers a new possibility. In TGA polymer weights up to 50 mg are heated to decomposition temperatures, for the most common polymers between 300 and 500°C under inert atmosphere. The decomposition process is analyzed gravimetrically, the decomposition temperate and rate as well as the residue formation are characteristic for each polymer. When the TGA is additional equipped with an evolved gas analysis (FTIR, mass spectroscopy- MS) characteristic decomposition products of polymer can be identified. The trapping of all decomposition products in the cold injection systems of pyrolyse-gas chromatography-mass spectroscopy (Py-GC-MS) offers an alternative evolved gas analysis. The complete decomposition products of polymers are separated by a chromatographic column and subsequently identified by use of MS pattern. Py-GC-MS is very common in quality control, due to its easy handling using MS spectra databases and high certainty. Unfortunately, in Py-GC-MS only a small sample amount of decomposition gases can be analysed (~1-10 µg).

A practicable alternative is the Thermal extraction desorption- gas chromatography-mass spectroscopy (TED-GC-MS). In this method, the advantages of TGA (high samples loadings and an easy cleaning) are combined with the advantages of GC-MS (easy identification of various hydrocarbon products with high certainty). In TGA, a large amount of sample is decomposed. The formed volatile decomposition products can be trapped on the surface of an adsorber material located at the outlet of TGA and collects a representative content of hydrocarbon decomposition. The decomposition products are analysed in a common TDS-GC-MS. The comfortable identification of characteristic decomposition products enables the fast identification of various polymers.

The present work shows first results about a systematic comparison of these methods: FTIR and Raman Imaging, TGA-FTIR and TED-GC-MS. The advantages and disadvantages of the methods are discussed and presented in relation to various polymeric materials.