Analysis of microplastics in theory and in practice

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Introduction

Due to the favorable properties of polymers, their production and thus their input into the environment has increased significantly in recent decades. Currently, FTIR or Raman spectroscopy are mainly applied for the analysis of microplastic particles (MP) in environmental samples. However, these methods have great difficulties in determining metrologically traceable MP values, especially with regard to the limiting values, as preferred in regulation. Therefore, we developed a systematic and fast thermoanalytical method called **TED-GC-MS** (thermal extraction desorption gas chromatography mass spectrometry), which determines mass contents. Now the current goal is the determination of its process parameters.

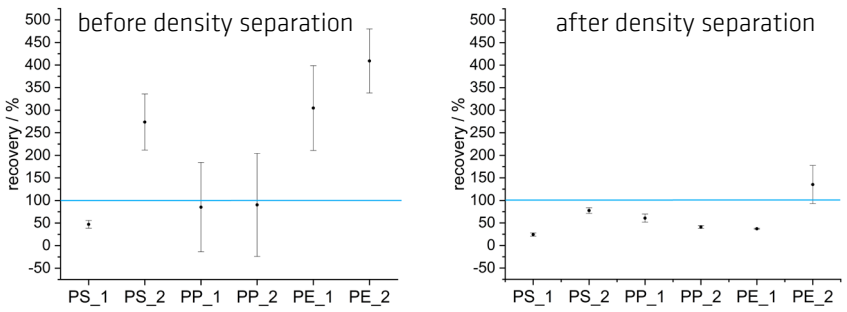
This poster illustrates the **theoretical requirements for MP analysis (left side)** and contrast them with the **current state of research (right side)**. Unexpected practical problems are presented and the relatively new method is discussed concerning the quality requirements of well-established methods such as LC- or GC-MS.

Homogeneity

- No homogenous distribution of MP spiked in 1 kg soil after homogenisation and cross riffling, 20 mg aliquot (analyzed fraction) is not representative

➡ Density separation of 1 kg of MP spiked soil to increase the relative analyzed fraction

TED-GC-MS measurements of soil samples



Appropriate standards/ reference materials

- No standards/reference materials available

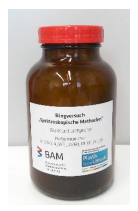
➡ In-house manufacturing of reference materials

Polymer powders

untreated PS, PET

aged PE, PS, PA

Polymer powders + matrices



water filtrate

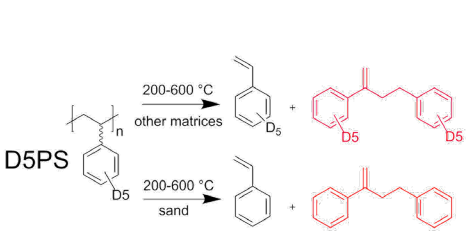
sediment

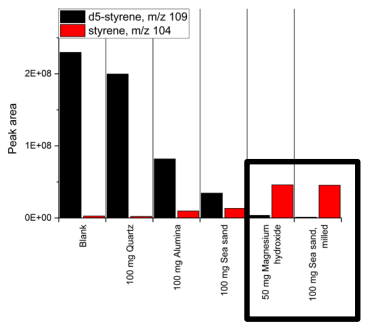
Internal Standard (IS)

- D5-polystyrene was selected as suitable IS for TED-GC-MS analysis
- H-D exchange during use

➡ Custom synthesis (very expensive)/in-house manufacturing of C13-standard

H-D exchange when using D5-polystyrene





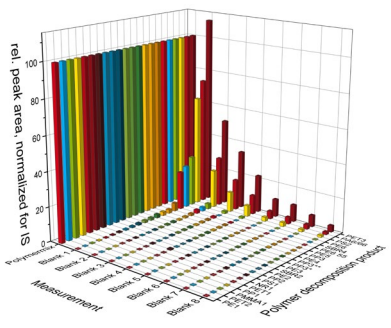
Repeatability

- Influenced by different, partially unknown parameters
- Parameters identified were varying solid phase masses and carry-over effects

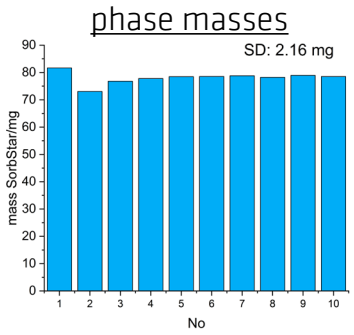
➡ Carry-over effect only relevant for one marker of PET, PA, PS

➡ Mass variations of solid phase mostly negligible

Carry-over effects



Variations of solid phase masses



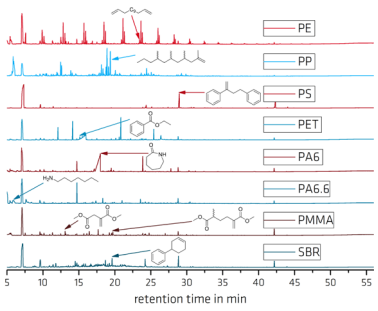
Specificity

- Unclear effects between decomposition products and matrices

➡ Up to five different decomposition products per polymer with four m/z values each are considered

➡ Negligible interference with the decomposition products, mainly fatty acids hinder the detection of PE

Selection of used marker substances



Chromatograms of pure PE and PE in matrices