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Analysis of microplastics in soil samples by using a thermal decomposition method

Axel Müller (1,2), Miriam Vogler (3), Peter Grathwohl (3), Henner Hollert (2), and Ulrike Braun (1)

(1) Bundesanstalt für Materialforschung und -prüfung, Germany , (2) Rheinisch-Westfälische Technische Hochschule Aachen, Germany, (3) Eberhard Karls Universität Tübingen, Germany

While plastics have become indispensable in our daily lives over the last decades, the input into the environment has been increasing concurrently. Plastics often end up in the environment because of intensive use and poor waste management practice. They are subjected to aging and fragmentation and finally be deposited as microplastic particles or in short microplastics (MP). MP are defined as particles originating from synthetic polymers between 1 μm and 5 mm.
Although the pervasive abundance of MP in aquatic environments has been demonstrated comprehensively, less is known about the occurrence and fate of MP in terrestrial ecosystems. It is still unclear if soil functions as a MP source or a sink for aquatic environments. MP can either be transported into water bodies by soil erosion or be retained in soils. The few studies published are not comparable because of non-existent harmonized and standardized methods for sampling, sample preparation, and analysis.
For an assessment of a potential exposure situation of MP, the determination of a mass content in the soil is crucial. Consequently, spectroscopic methods like Raman or FTIR are not suitable, as they deliver information about the shape and size of individual particles. Therefore, we show the application of ThermoExtractionDesorption-GasChromatography-MassSpectrometry (TED-GC-MS) for MP analysis in the soil. In this method, the soil sample is heated up to 600 °C in a nitrogen atmosphere. The decomposition gases are sorbed on a solid phase, then transferred to a GS-MS system where they are desorbed, separated and identified. The method allows the rapid identification of individual polymers through the detection of specific decomposition products, but also the quantitative determination of the MP mass. Besides thermoplastics, elastomers originated from tire abrasion can be detected.
In the present study, several terrestrial ecosystems in south-west Germany were systematically sampled. Subsequent sample preparation included sieving in fractions of 5-100 μm, 100-1000 μm, and 1-5 mm. MP were extracted by density separation using ZnCl2 solutions. The detection was done by TED-GC-MS measurements. Data of agricultural areas and floodplains are presented exemplarily. A quantitative assessment of highly occurring MP from littering as well as tire abrasion is conducted.