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Pathways of microplastics in soils - Detection of microplastic contents in compost using a thermal decomposition method

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The ubiquitous presence of unintended plastics in the environment has been an issue in scientific studies and public debate in the last years. It is well known that oxidative degradation and subsequent fragmentation, caused by UV-radiation, aging and abrasion lead to the decomposition of larger plastic products into microplastics (MP). Possible effects of these MP on ecosystems are still unclear. Recent studies on MP findings are focused mainly on aquatic systems, while little is known about MP in terrestrial ecosystems. Fermentation residues, sewage sludge and compost represent an input path of plastics in soils through targeted application in agriculture. For this reason, analysis of the total content of plastic in organic fertilizers as a sink and source of MP in ecosystems is of high interest.

In 2017, approximately 14.2 million tons of biodegradable waste were collected, from which 3.9 million tons of compost was produced. Improper waste separation result in plastic fragments in the biowaste, some of which end up in the compost and might be degrade to MP. In Germany, compost is used as fertilizer in agriculture and landscape design, hence MP could enter the soil by this pathway. Spectroscopic methods such as Raman or FTIR are not suitable for determining the mass content of microplastic, as these output a particle number.

Therefore, we show the application of ThermoExtractionDesorption-GasChromatography-MassSpectrometry (TED-GC-MS) as a fast, integral analytical technique, which in contrast to the spectroscopic methods does not measure the number of particles but a mass content. The sample is pyrolyzed to 600°C in a nitrogen atmosphere and an excerpt of the pyrolysis gases is collected on a solid phase adsorber. Afterwards, the decomposition gases are desorbed and measured in a GC-MS system. Characteristic pyrolysis products of each polymer can be used to identify the polymer type and determine the mass contents in the present sample. This method is well established for the analysis of MP in water filtrate samples. Here, we will first demonstrate the use of TED-GC-MS for compost.

This current study will also give inside in various important aspects of sample preparation, which include a meaningful size fractionation, a necessary density separation regarding the removal of inorganic contents and at finally a homogenization.