DIFFERENTIAL SCANNING CALORIMETRY COUPLED WITH FT-IR. A SENSITIVE METHOD FOR MEASURING MICROPLASTICS IN SEWAGE SLUDGE, BIOGAS DIGESTATE, FOOD WASTE COMPOST, AND ROAD DUST?

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OVERVIEW

• Microplastics in solid waste
• Properties of plastics affecting analyses
• DCS/FT-IR
• Results from spiked samples and environmental samples
• Conclusions
MICROPLASTICS IN SOLID WASTE

• Receive attention due to recycling for soil amendments
• Estimates of 0.13-0.85 kg MP pers⁻¹ yr⁻¹ from sewage to soil and 0.25-1.7 kg pers⁻¹ yr⁻¹ from building and road wear*
• Farmers, consumers and authorities fear negative impact on soil and food
  – Accumulation of plastics in soil (or loss to water)
  – Effects on soil organisms
  – Plastics as a vector for organic pollutants

Analysis of plastics in solid matrices is far more complicated than in water

PROPERTIES OF PLASTICS AFFECTING ANALYSES

- Do not dissolve and disintegrate into monomers
- May consist of mixtures/laminates

But:
- Have well defined melting points/glass transition temperatures
- Have well defined FT-IR spectra
- Boyant densities $<1.2 \text{ g cm}^{-3}$
DIFFERENTIAL SCANNING CALORIMETRY - FOURRIER TRANSFORM INFRARED SPECTROMETRY (TG/DSC/FT-IR)

- STA: Simultaneous thermogravimetric analysis
- DSC: Measuring endo- and exothermic reactions during heating
- FT-IR: Continuous scanning of gases released as temperature increases
STA-DSC

Oven with thermocouples containing sample and reference sample

Endothermal reaction

DSC curve
FT-IR gass cell

Oven with sample

Polypropylene

FT-IR spectrum

TG curve (weight loss in %)

DSC curve (ΔT vs ref.)
Compost spiked with 0.1%, 1% and 10% PP
FT-IR OF ROAD DUST AND CAR TIRE COMPARED

Supernatant from road dust at 1.2 g/ml

Road dust before separation by flotation

Pure car tire

Road dust vs. cellulose
CONCLUSIONS

• TG/DSC/FT-IR has a high potential for quantification of microplastics
• Small sample size (<50 mg) requires highly homogeneous samples
• We currently:
  – Look into modification of melting behavior due to waste processing
  – Build an FT-IR library of modified and mixed plastics
THANK YOU FOR YOUR ATTENTION!

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