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

Dr Erik J Joner

Norwegian Institute of Bioeconomy Research (NIBIO)

Ås, Norway

Erik.Joner@nibio.no

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

*Nizzetto L, Futter M, Langaas S (2016) Are agricultural soils dumps for microplastics of urban origin? Environ Sci Technol 50: 10777

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

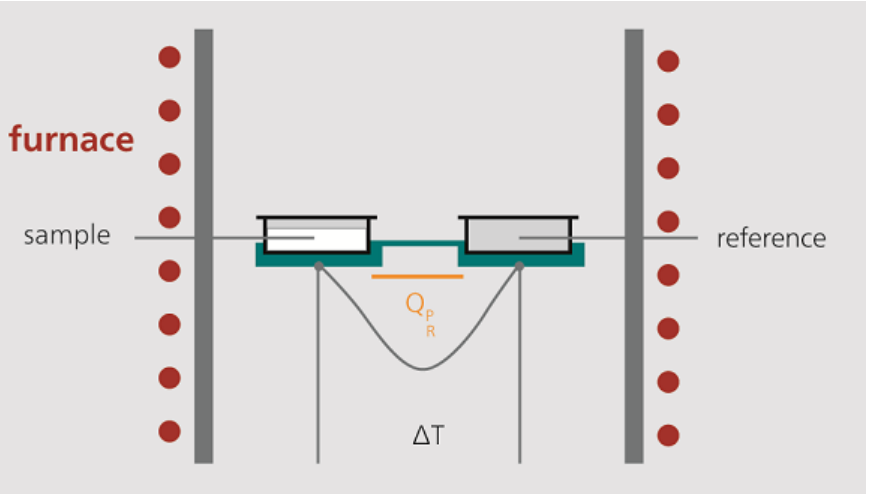
✓ Have well defined FT-IR spectra

✓ Boyant densities <1.2 g cm^{-3}

DIFFERENTIAL SCANNING CALORIMETRY - FOURRIER TRANSFORM INFRARED SPECTROMETRY (TG/DSC/FT-IR)

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

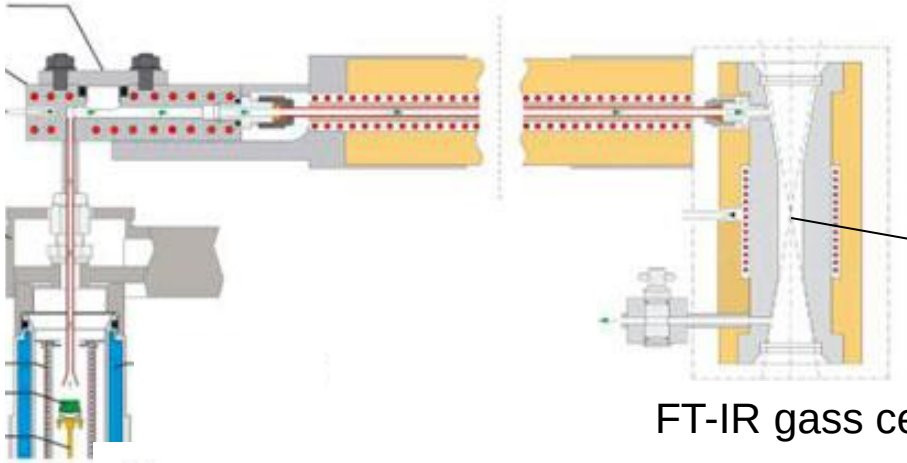
STA-DSC



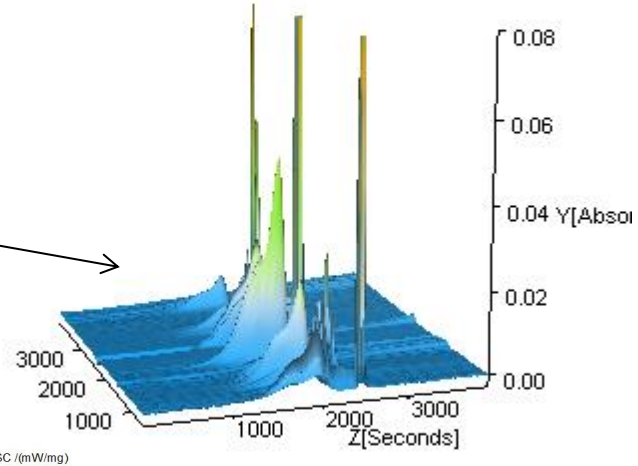
Oven with thermocouples containing sample and reference sample

Endothermal reaction

DSC curve

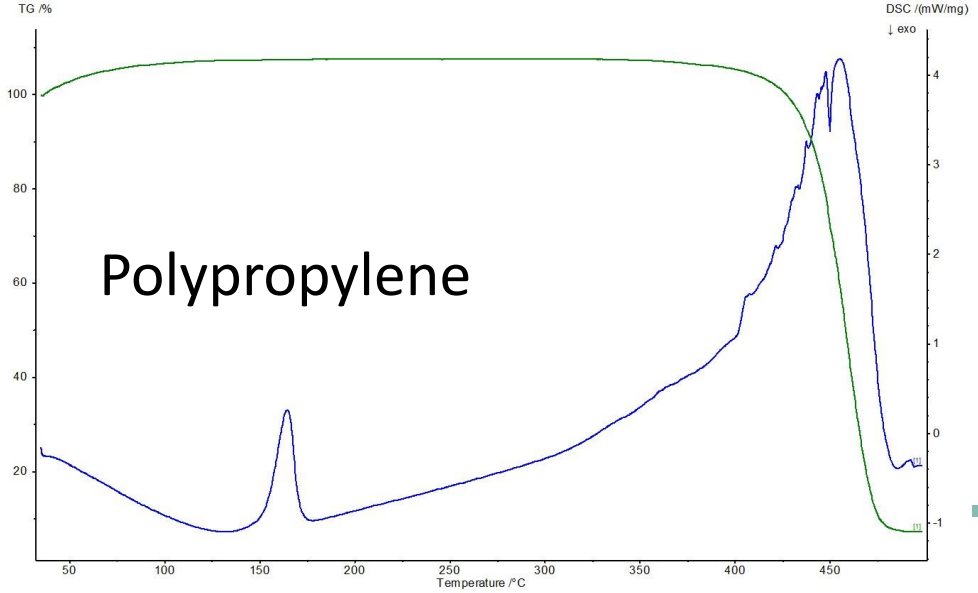


FT-IR gass cell



FT-IR spectrum

Oven with sample



Polypropylene

TG curve (weight loss in %)
DSC curve (ΔT vs ref.)

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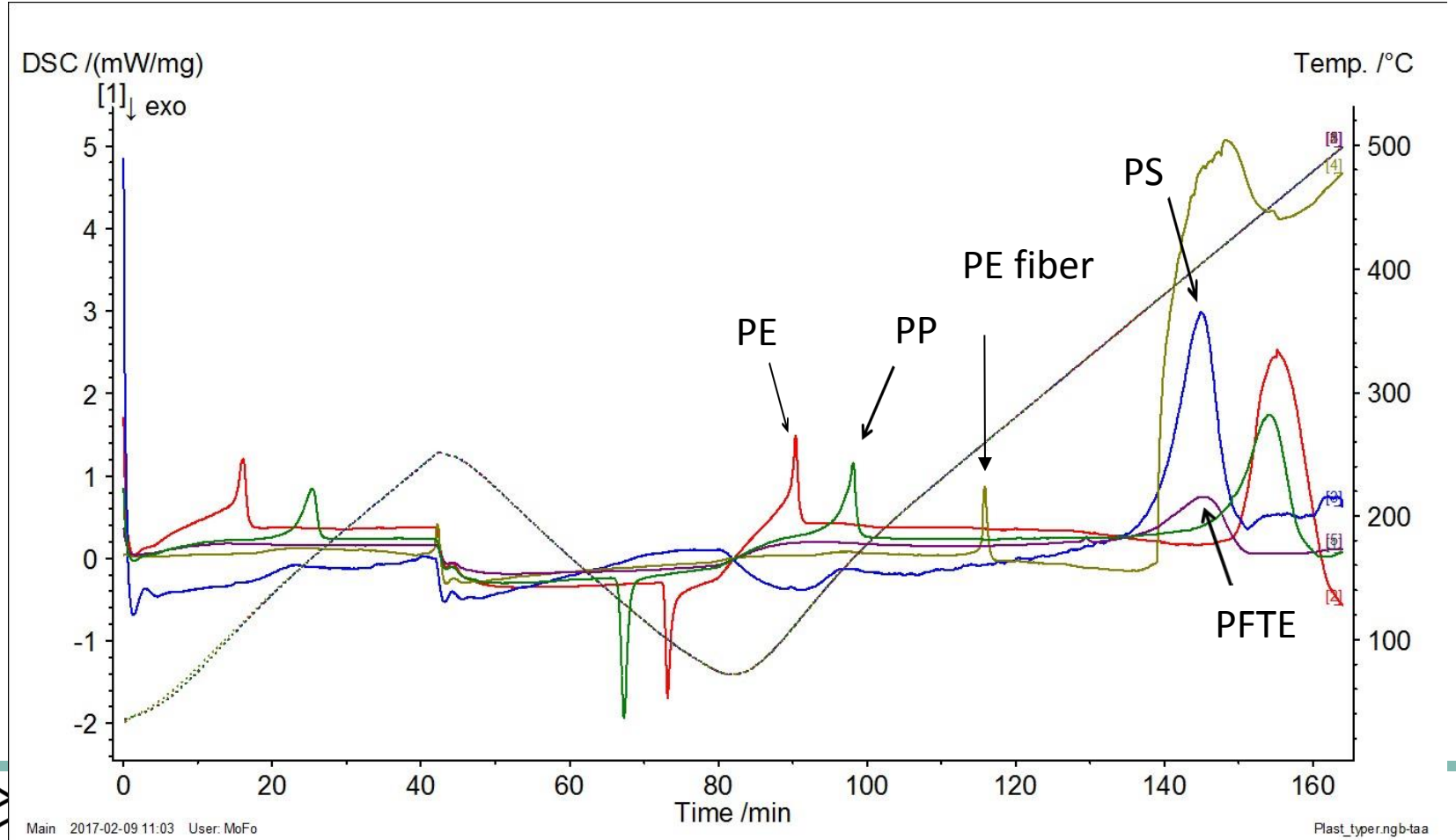
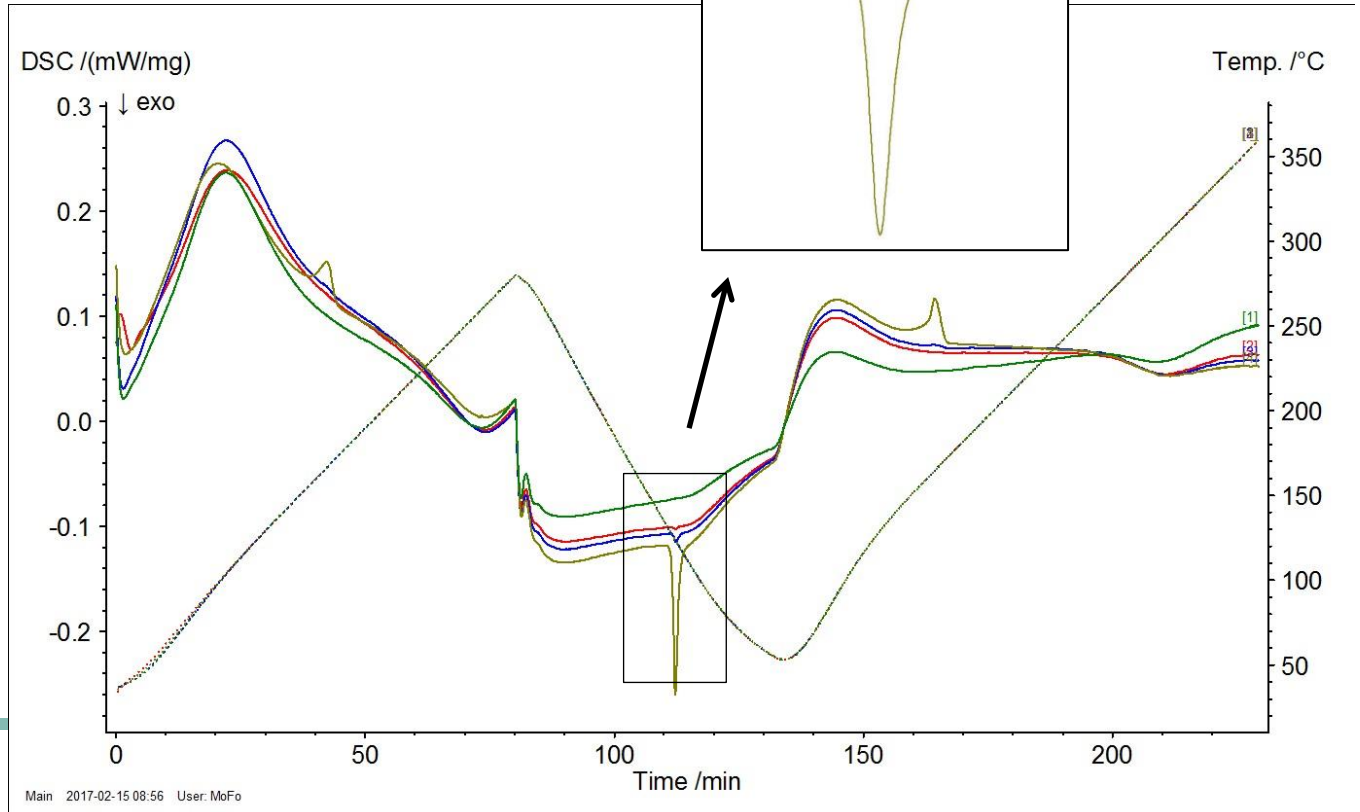

DSC /(mW/mg)
[1]↓ exo
Temp. /°C
PS
PE fiber
PE
PP
PFTE
Time /min
Main 2017-02-09 11:03 User: MoFo
Plast_typer.ngb-taa

THERMAL SIGNAL IN COMPOST

Compost spiked with 0.1 %, 1 % and 10 % PP



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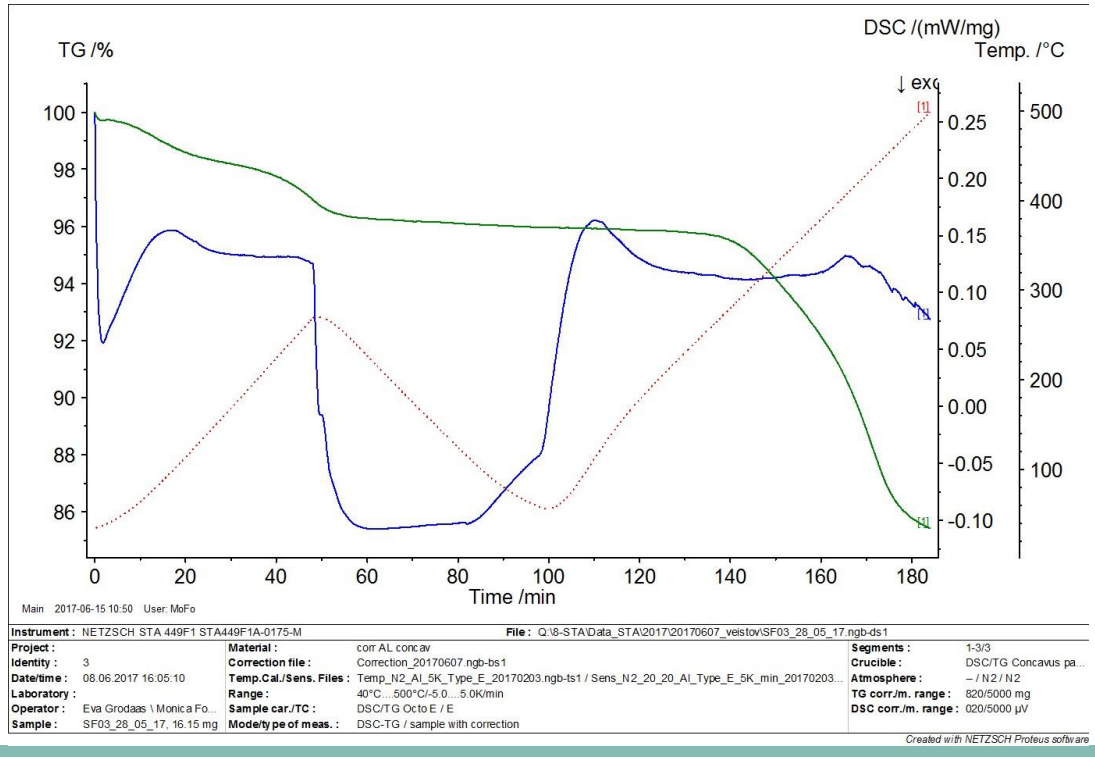
TG-DSC FROM ROAD DUST

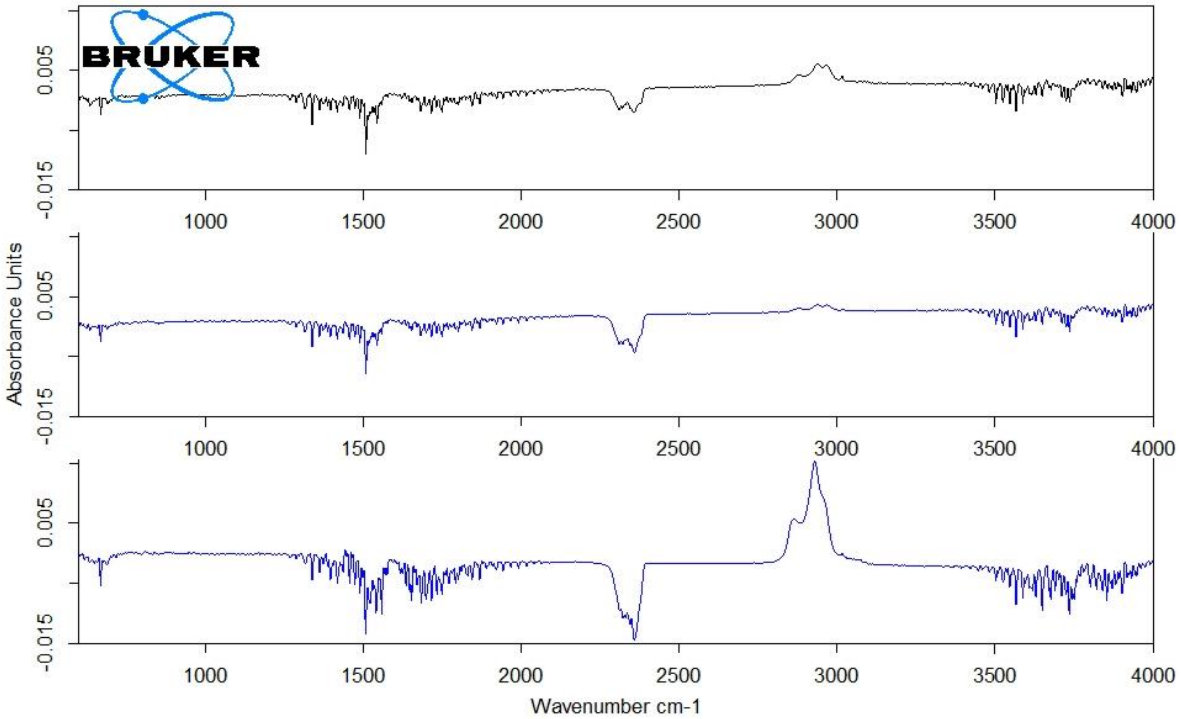


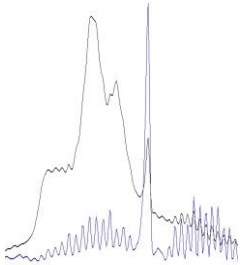
FT-IR OF ROAD DUST AND CAR TIRE COMPARED

Supernatant from road dust at 1.2 g/ml

Road dust before separation by flotation

Pure car tire





Road dust vs. cellulose

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Q:\8-STA\Data_STA\2017\20170327_Plast\Veistoev_Fos_1.0	Norwegian Forest & Landscape Institute, Norway ;	TG-FTIR ! Bei 200°C ge 03.04.2017
Q:\8-STA\Data_STA\2017\20170327_Plast\Vinterdekk_04.0	Norwegian Forest & Landscape Institute, Norway ;	TG-FTIR ! Bei 200°C ger 02.05.2017

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

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THANK YOU FOR YOUR ATTENTION!

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