Degradation Behaviour of a Seed Coating in an OECD TG 307 Simulation Test and Quantification with Pyrolysis-GC/MS and FFF-MALS-RI

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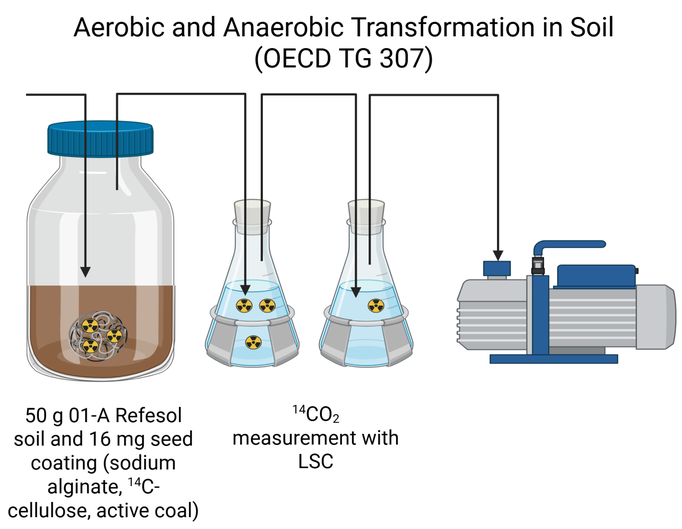
Introduction

The **fate of polymers** has been in the focus of the new restriction (Commission Regulation (EU) 2023/2055) issued by the European Commission [1] on microplastics intentionally added to products. The restriction is based on the biodegradation of polymers, which is determined according to OECD test guidelines (TG). While natural polymers are considered degradable by default, our project has shown that combining different natural polymers in a seed coating (sodium alginate, cellulose, active coal) results in **<60% mineralisation in 28 days** with an OECD TG 301 [2] test. Therefore, a **simulation test** (OECD TG 307 [3]) was applied to learn more about the degradation behaviour of this seed coating material.

Materials & Methods



The degradation of the seed coating is measured by analysis of $^{14}CO_2$ and quantitative analysis with Pyrolysis-GC/MS. Polymer extraction and subsequent analysis is performed with the whole sample. Sacrificial sampling is carried out in duplicates throughout the incubation time.

Figure 1: Simulation test (OECD TG 307) to determine the degradation of the seed coating.

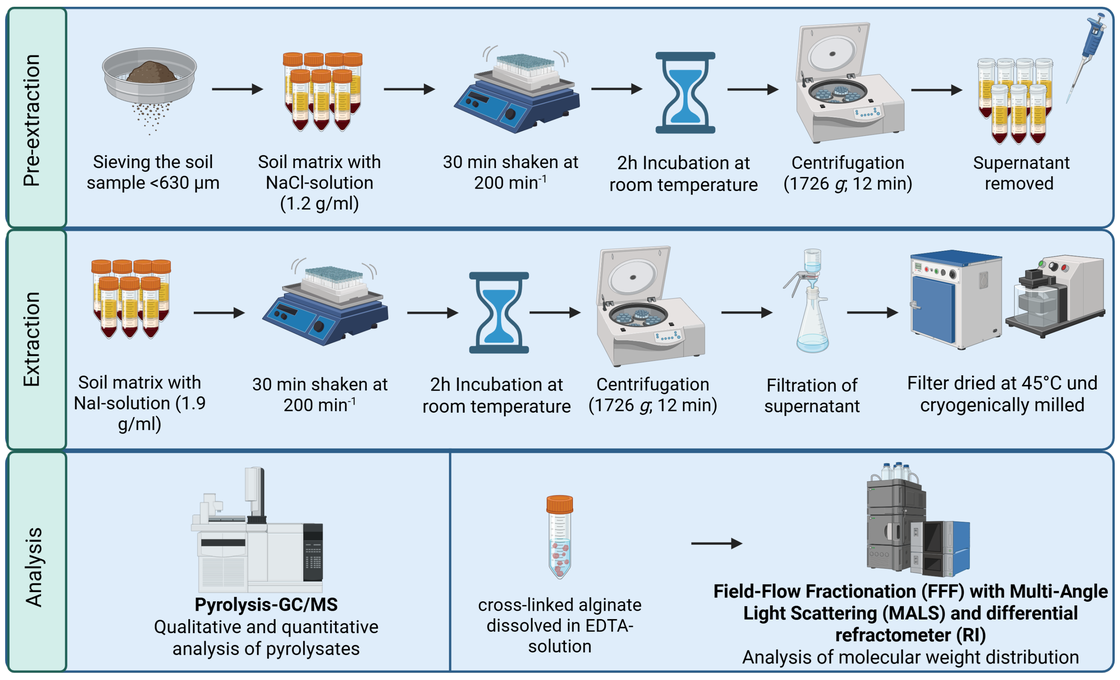


Figure 2: Extraction and analysis of soil samples from simulation test OECD TG 307.

Results & Discussion

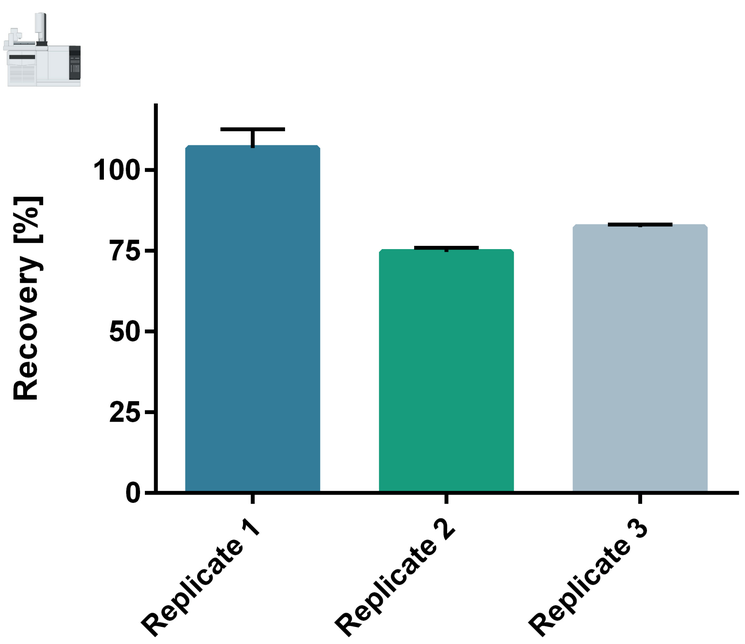


Figure 3: Recovery of the extracted seed coating (1 mg/g soil) determined with Pyrolysis-GC/MS. Duplicate measurements of the soil samples (n=3) was completed and methylglyoxal was used as a specific pyrolysate for the seed coating.

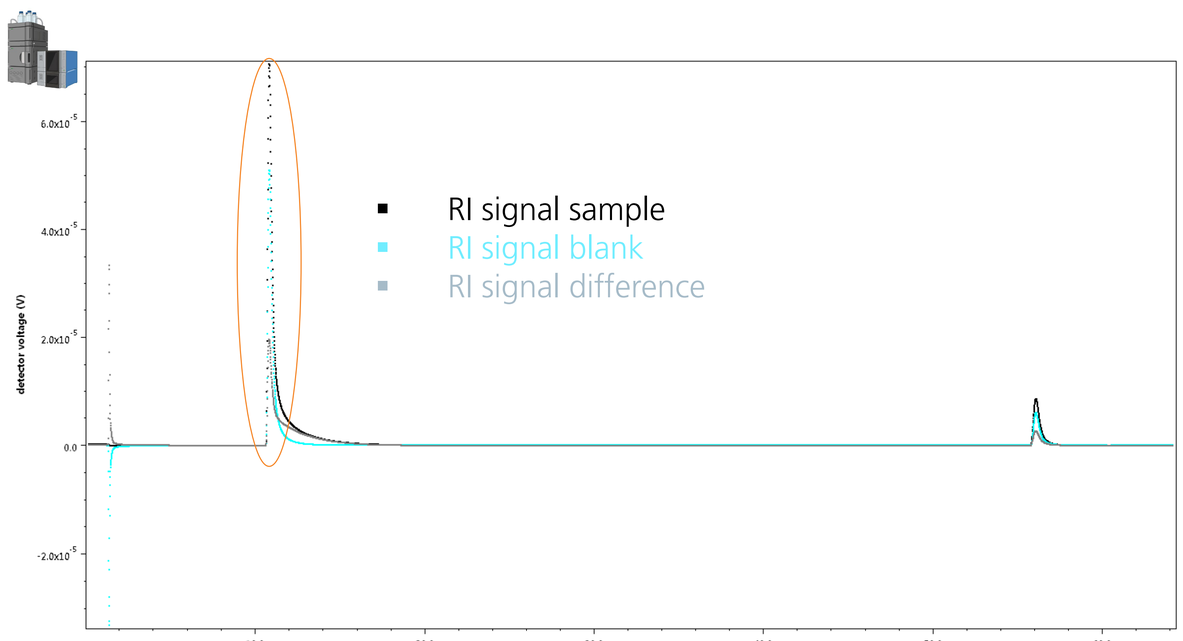


Figure 4: FFF-MALS-RI measurement of dissolved alginate in 0.2 M EDTA (5 mg alginate/5 ml EDTA-solution) after subtraction of a blank measurement of 0.2 M EDTA-solution. Alginate peak marked in the chromatogram (orange circle).

- Recovery of seed coating between 74.6 and 106%
  - Increased recovery for sample 1
  - No outliers identified with Grubb's test (α=0.05)
  - Results within the recoveries defined in OECD TG 307 for non-labelled chemicals (70-110%)
- Homogeneity of the sampled filters
  - 10 sub-samples tested with a variation of less than 10%
- Testing of limit of detection (LOD) and limit of quantification (LOQ)
  - <1 mg seed coating/g soil

- Development of extraction method for FFF-MALS-RI
  - Various concentrations of cross-linked sodium alginate in 0.2 M EDTA-solution are tested
- Extraction method applied to seed coating samples
  - Validation with filter samples from soil extraction

The developed extraction method can be used for a **quantitative analysis** on the degradation of **sodium alginate and cellulose** as part of a **seed coating**.

Outlook

- Determination of LOD/LOQ for extraction method with Pyrolysis-GC/MS
- Performance of OECD TG 307 with seed coating samples and subsequent analysis with Pyrolysis-GC/MS and FFF-MALS-RI

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References
[1] European Commission, "COMMISSION REGULATION (EU) 2023/2055 of 25 September 2023," 2023.
[2] Organisation for Economic Co-operation and Development, "OECD guideline for testing of chemicals 301 - Ready Biodegradability," 1992.
[3] Organisation for Economic Co-operation and Development, "OECD guideline for testing of chemicals 307 – Aerobic and Anerobic Transformation in Soil," 2002.

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