Development of a Modified Screening Method for the Degradation of Polymers and Validation with ^{14}C-radiolabelled Alginate

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Introduction

The **fate of polymers** is mostly unknown. A fast screening method is urgently needed to obtain a **projection of the biodegradability** of polymers during polymer development. In order to address this issue, a **modified screening method** based on the OECD 301B guideline [1] with a high throughput of polymers has been developed. In comparison to the guideline test various parameters were changed and the set-up was simplified to ensure a quick assessment of the biodegradability.

Materials & Methods

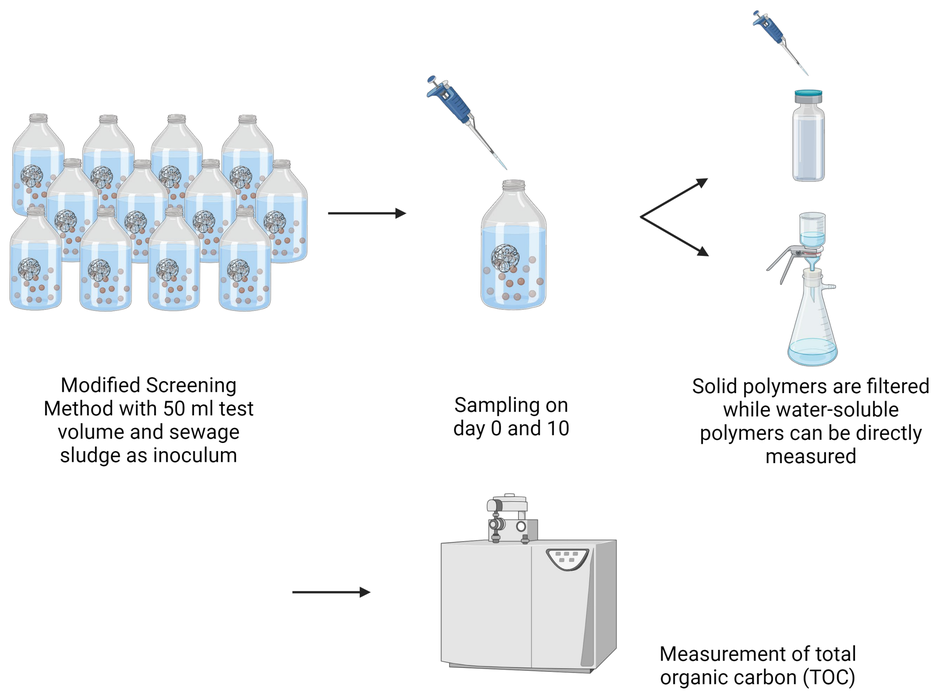

Figure 1: Modified screening method to determine polymer mineralisation.

Table 1: Modified screening method to determine polymer mineralisation.

Test parameters	Modified Screening Method	OECD 301B Test
Test volume [ml]	50	800-3000
Sewage sludge [g dry mass/L]	1-3 for water-soluble polymers 6 for solid polymers	1-3
Incubation time [d]	10	28
Sampling times	2	8
Incubation system	Closed system	Flow-through system
Analytical endpoint	Direct TOC-measurement of test volume	Indirect TOC-measurement by quantification of trapped CO_2

Results & Discussion

Table 2: Comparison of the recovery in the modified screening test to the measured mineralisation in the OECD 301B test.

Substances	Recovery screening d0 [%]	Recovery screening d10 [%]	Mineralisation screening d10 [%]	Mineralisation OECD 301B Test d28 [%]
Sodium alginate	99.8	7.74	92.1	30.8
Carboxymethyl cellulose	103	75.7	27.3	30.5
Gum Arabica	98.4	30.0	68.4	84.8
Reference substance	104	4.97	99.0	91.6

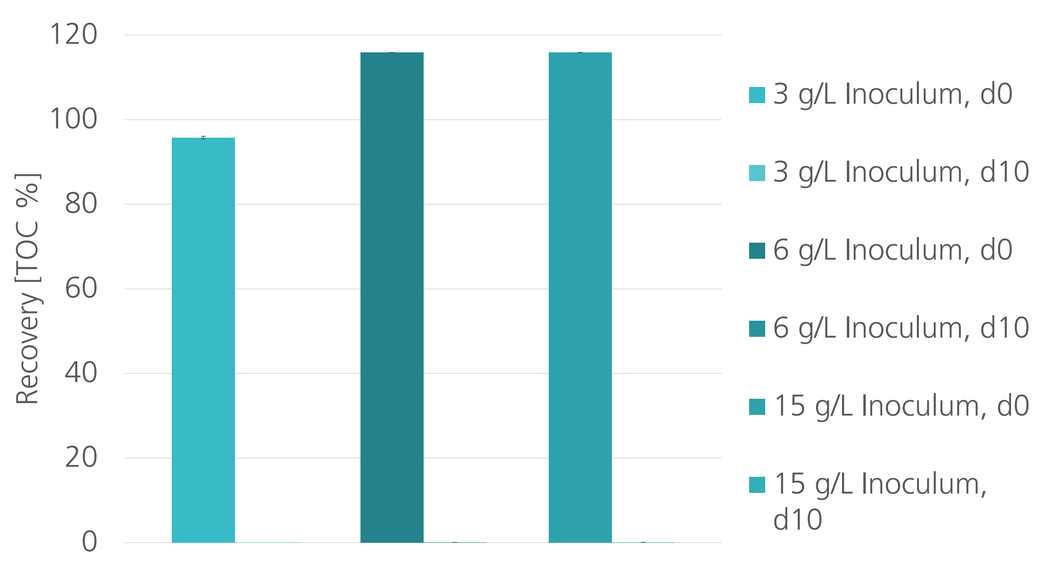

Figure 2: Comparison of different sewage sludge concentrations with Indian psyllium husks for the modified screening test.

- Comparable results between the two methods
  - Testing done in triplicates with a variation of less than 10 %
- Only significant difference for the results of sodium alginate
  - Screening results reproduced and no adsorption of the sodium alginate to the glass or the sludge observed
  - Experimental error assumed, OECD 301B test will be redone
- **Advantages of the screening method**
  - **Direct measurement of test volume**
  - **Saves time and space**
  - **Higher sample throughput possible**
  - **Prediction of degradation in OECD 301B possible**

- Testing of solid (non-soluble) polymers possible
  - Modified screening experiments with Indian psyllium husks successful
- Different sewage sludge concentrations tested for solid polymers
  - Day 10 results with a sewage sludge concentration of 3 g/L were not valid
    - Below the limit of quantification of the TOC-analyser
  - Quantification of higher sewage sludge concentrations possible

Modified screening method can be used for a qualitative conclusion on the degradation for water-soluble and solid polymers.

Outlook

- Synthesis of the ^{14}C-radiolabelled sodium alginate
- Validation of the modified screening method with ^{14}C-radiolabelled sodium alginate

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References

[1] Organisation for Economic Co-operation and Development, "OECD guideline for testing of chemicals 301 - Ready Biodegradability," 1992.