

Biodegradable Polymer from Agriculture Soils

Soxhlet extraction method using the UniversalExtractor E-800

1. Introduction

A simple and reliable procedure for the extraction of the biodegradable polymers polybutylene adipate-co-terephthalate (PBAT) and polylactic acid (PLA) used in mulch films from agricultural soils is introduced. Commercial biodegradable mulch films are mainly composed of synthetic polyesters that undergo the process of biodegradation in agricultural soils. In this study, agricultural soil samples were spiked with commercial biodegradable mulch film containing PBAT and PLA.

2. Experimental

Equipment: UniversalExtractor E-800

Sample: Compost & Polymer: LUFA 6S reference agricultural soil, sieved to < 2 mm (LUFA, Speyer, Germany), biodegradable mulch film, *gvz-rossat ag* (Otelfingen, Switzerland), Article Nr. 32.00009, with 56.3 w% PBAT and 13.7 w% PLA

Procedure: Samples were freeze dried, mixed and weighed into a cellulose thimble. Compost samples were spiked with PBAT and PLA before being extracted according to the parameters listed in Table 1. The extracts were quantified using ¹H-NMR.

Table 1: Soxhlet extraction with the UniversalExtractor E-800.

Step	Value
Extraction method	Soxhlet
Solvent	Chloroform : Methanol 9:1 (v:v)
Extraction Heating level	10 cycles 11
Soxhlet valve opening time	Long
Rinse	0 min
Dry (Step 1) Heating level	<input checked="" type="checkbox"/> AP, 60 min 5
Solvent volume [mL]	160



3. Results and discussion

The results of the spiked extraction recoveries of PBAT and PLA in mulch films are presented in Table 2.

Table 2: Overview of spiked extraction recoveries of PBAT and PLA in mulch films (averages ± standard deviations; n= 3)

PBAT spiked [mg]	Recovery PBAT [%]	PLA spiked [mg]	Recovery PLA [%]
100.3 ± 0.1	99.9 ± 1.0	24.40 ± 0.03	101.0 ± 0.4
45.0 ± 0.1	99.3 ± 0.3	10.95 ± 0.02	101.4 ± 0.5
21.0 ± 0.1	98.0 ± 0.6	5.12 ± 0.02	98.8 ± 1.5
10.0 ± 0.0	96.8 ± 0.4	2.43 ± 0.00	97.0 ± 1.7
4.5 ± 0.0	96.0 ± 1.2	1.10 ± 0.00	94.0 ± 0.5
2.0 ± 0.0	98.2 ± 0.8	0.49 ± 0.00	92.4 ± 1.2

4. Conclusion

The extraction of PBAT and PLA in mulch films using the UniversalExtractor E-800 allows to reliably and accurately quantify PBAT and PLA. The method can likely be extended to other biodegradable mulch films containing varying amounts of PBAT and PLA.

5. Acknowledgment

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6. References

- [1] Nelson, T. F., S.C. Remke, H.-P. E. Kohler, K. McNeill, M. Sander; Quantification of Synthetic Polyesters from Biodegradable Mulch Films in Soils. *Environmental Science & Technology* 2020 54 (1), 266-275; DOI: 10.1021/acs.est.9b05863

For more information, please refer to Application Note 836/2024.

