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2019/LAB10

Study report

Compostability of biopolymer samples (Nr: 2019/LAB10)

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Client's representative:	Kálmán Magyar - CEO
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Study performed by:	Zsolt Varga – researching engineer
Report verified by:	Dr. Sándor Dér – head of research
Order ID:	based on order No. 2019/11/29
Study location:	Profikomp Környezettechnika Zrt. Research laboratory
Study commencement:	07 01 2020
Date of measurement:	06 02 2019
Date:	Gödöllő, 14th February 2020

1. Introduction

AMCO Kft. commissioned Profikomp Környezettechnika Zrt. to perform the study of the packaging material with biopolymer basis titled „Green-Fill – Biodegradable loose space filling material".

The sample providing basis for the study is, according to the information given by the client, based on starch, a loose space filling material (hereinafter referred to as: biopolymer samples), made available by the client.

The studied sample is marked: PRK 19/110

After the identification of the essential sample parameters (moisture content, organic carbon and ash content) respirometry testing was performed on the samples using an Oxitop Control device measuring oxygen consumption. On the completion of the experiment the results were assessed.

2. Measurement methods applied, means of measurement

2.1 Finding moisture content, organic carbon and ash content

The moisture content was found by measuring the occurring mass loss after drying the original samples in a drying cabinet until mass has become constant on a temperature of 103 +/- 2°C.

The total organic carbon (TOC) content was found using an elementary analyzer.
The carbon content of the samples in the elementary analyzer was determined using a thermal conductivity detector (TCD), by a simple decomposition to compounds after a quick oxidation on high temperature.

The ash content was determined by measuring the occurring mass loss after heating the air-dry samples in a laboratory heating furnace on a temperature of 700°C± 5°C.

2.2 Respirometry (value AT25)

During the test the oxygen consumption of the biopolymer sample (mg O_2/g sample dry material) was in a closed respirometry system using an Oxitop Control device. Incubation was performed on a temperature of 40°C for 25 days in ambient conditions characteristic of domestic composting.

The principle of determining respiratory intensity

Respiratory intensity is a static respirometry index value which is a method standardized for determining compost maturity. The Oxitop device operates by the principle of determining pressure change occurring within a closed system by constant incubation temperature and duration. During the decomposition of the biodegradable organic compounds contained in the sample the microorganisms consume oxygen and produce carbon-dioxide. The carbon-dioxide generated is absorbed in the aqueous solution of sodium hydroxide (NaOH), producing vacuum within the closed system. This decrease in pressure is measured, and this value is directly proportional to the oxygen consumption accompanying the decomposition of the sample [mg O_2/g dry material].

Test details

- Inoculum: mature vermi-compost to model domestic composting ($AT25_{average}$= 32,5 mg O_2/g dry material)
- Sample preparation: biopolymer samples were chopped to uniform 1x1 cm pieces in their original (air-dry) condition.

- Mass of the samples tested: the reaction vessel of the device is suitable for accepting at least 30 g of the mixture of prepared sample and inoculum (the maximum thickness of the substrate is 1 cm).

- Placing the samples: the prepared biopolymer samples were blende with the inoculum, and the mixture obtained was place in the reaction vessels in 6 repetitions.
- Treatment process: The duration of incubation is 25 days during which continuous oxygen supply must be provided for, therefore oxygen should be supplied as required.
- Measuring oxygen consumption: the device used makes measurements automatically at least every hour and stores data in its memory.
- Calculating the total 25-day oxygen consumption (AT_{25}): during the test the net cumulated AT_{25} value of the samples is obtained based on the comparison with the inoculum (control sample).

Fig. 1: Oxitop respirometry

2.3 Disintegration test

The disintegration of the samples was performed in line with the relevant requirements of the international standard ISO 16929 – „*Plastics – Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test*". The compost substrate produced was sieved together with the samples through a 2 mm sieve, this provides us with the level of disintegration.

3. Results

3.1 Moisture content, total organic carbon content and ash content of the biopolymer samples

Sample name	Sample code	Moisture content [m/m%]	C [% dry mat.]	Ash content [% dry]
Amco space filler	19/110	9,19	46,882	0,286
			46,758	0,308
			46,652	0,242
Average			**46,764**	**0,279**

Table 1: Moisture, total carbon (TOC) and ash content of the samples

3.2 Respirometry of biopolymer samples

Sample	Vermicompost	19_110	Unit of meas.
25-day respiration activity	32,2	49,4	mgO_2/g dry m.
	32,7	52,9	mgO_2/g dry m.
		51,7	mgO_2/g dry m.
		49,4	mgO_2/g dry m.
		53,2	mgO_2/g dry m.
		51,9	mgO_2/g dry m.
Average	**32,5**	**51,3**	mgO_2/g dry m.
Control corrected		**18,9**	mgO_2/g dry m.

Table 2: AT_{25} values, and net AT_{25} values of biopolymer samples corrected with inoculum (control sample)

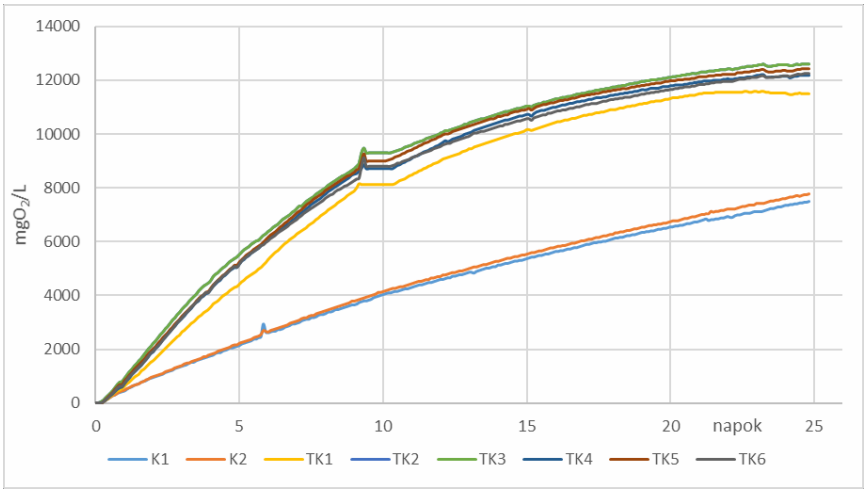

Fig. 2: Respiration activity of the tested biopolymer samples corrected with control

Fig. 3: Biopolymer samples on day 0 (respirometry)

Fig. 6: Biopolyimer samples on day 25 (respirometry)

3.3 Disintegration test

The maximum mass decrease was 100%, no recognizable and measurable sample was caught in the 2 mm sieve and in the reaction vessels.

3.4 Assessment of the measurement results

The starch-based biodegradable space filler in the closed respirometer on a temperature of 40°C, in circumstances characteristic of domestic composting started degrading verifiably during the test. After the quick initial contraction disintegration occurred in 100% visually during the 25-day incubation period, no sample measurable according to standard ISO 16929 remained in the reaction vessels.

Based on the respirometry the disintegration ratio calculated for the organic carbon content

was 36,9%. The average respiration activity value of the biopolymer samples was $AT25_{net}$ =

492,7 mg O_2/g dry material.

Based on the tests performed the biopolymer samples prove to be suitable for domestic and small-sized prism composting technologies, however, further tests are necessary to verify this (based on MSZ EN 13432).

Aerated covered systems are also suitable for a higher temperature necessary to provide for the conditions of disintegration. Utilization in factory scale composting plants faces no technological objects.