



smartfiber AG
z. H. Frau Finken
Im Weidig 12
07407 Rudolstadt

your message from	your reference	our reference	telephone number	date
27.03.2017		4 . 0 / B 1 0 - 1 / 2 0 1 7	03672 379-521	08.06.2017

TEST REPORT

1. *General*

test report number:	4 . 0 / B 1 0 - 1 / 2 0 1 7	
client:	smartfiber AG, Ms. Finken	
test item:		internal laboratory number
sample 1	smartcel sensitive 1703024	3019
sample 2	SeaCell LT 1703022	3020
sample 3	SeaCell MT 1703023	3021
sample drawing:	by client	
test aim:	Investigation of degradability, part 1: soil-burial test	
date of receipt:	28.03.2017	
processing period:	18.04. - 02.06.2017	
processor:	Ms. C. Stengel, Ms. Dr. J. Bauer	
subcontractor:	no	
test method:	1) own method	
comment:	no	
report distribution:	1 copy for client 1 copy for TITK	

The tests were carried out between the current date and the report date. The results of the measurements and analysis refer exclusively to the test samples. This test report is only valid with the signature of the laboratory director or his representative legal. It may only be fully reproduced. Copying of excerpts require a written approval of the laboratory.

2. Test method description

To investigate the resistance of materials against microorganisms these materials are buried into microbiological active soil. After storing under defined conditions the degradation through microorganisms is determined by gravimetric analysis. Gravimetric analysis is carried out at multiple, increasing measure time points in correlation with the storage time.

Materials and test conditions:

samples:	K	control material: plastic net	
	3019	smartcel sensitive 1703024	cellulose fiber
	3020	SeaCell LT 1703022	cellulose fiber
	3021	SeaCell MT 1703023	cellulose fiber
Sample preparation:	Weighing of 0,50 g each fiber sample and insertion into net-bag		
soil:	- pH-value 6,5 (set: 4-7) - microbiologically active soil (universal flower soil): -97,81 % tear-out force reduction of cotton mesh after 7 d (set: min. -75 %) - 146 % (± 12 %) water content (= 60 % of water capacity of 243 %)		
ammonium nitrate solution:	1 g/l ammonium nitrate, 0,2 g/l K_2HPO_4		
test approach:	3 test specimens each sample in approx. 1 l soil in glass with screw cap		
incubation conditions:	at 29°C and min. 70 % relative humidity		

Preliminary tests:

a) Determination of water content of soil:

- Filling of 50 ml soil each beaker
- Drying for at least 24 h at 104 °C
- Gravimetric measurement before and after complete drying
- Calculation of water content (WC) in acc. to formula:

$$WC = \frac{m_{water}}{m_{soil,dry}} = \frac{m_{soil, humid} - m_{soil, dry}}{m_{soil, dry}} \cdot 100 \%$$

b) Determination of water capacity:

- Filling of sintered glass crucible size 3 with 50 ml soil until approx. 1 cm underneath edge
- Putting into beaker and filling of beaker with water until a water-level of 1cm above filter plate
- Residence time: 12 – 16 h
- Suction of excessive water
- Drying for at least 24 h at 104 °C
- Gravimetric measurement of the humid and dried soil
- Calculation of water capacity (WHV):

$$WHV = \frac{m_{water, max}}{m_{soil, dry}} = \frac{m_{soil, humid} - m_{soil, dry}}{m_{soil, dry}} \cdot 100 \%$$

c) Determination of microbiological activity of the soil:

- Cutting of 2 x 5 cotton mesh with dimensions of 3,5 x 10 cm
- Horizontal burying of the cotton mesh in soil with WC app. 60% WHV in petri dishes
- Storage at 29 °C and min. 70 % relative humidity for 7 d
- Determination of tear-out force and calculation of tear-out force reduction:

$$\begin{aligned} & \text{tear - out force reduction (\%)} \\ & = \frac{(\text{original tear - out force} - \text{tear - out force after soil storage})}{\text{original tear - out force}} \cdot 100\% \end{aligned}$$

Procedure:

Preparation of soil:

- Adjusting of humid content of soil to 60% (± 5 %) of the water capacity by addition of 47 g ammonium nitrate solution each 100 g soil acc. following calculation:

$$m_{\text{water addition}} = \frac{m_{\text{soil}} \cdot (WC_{\text{set}} - WC_{\text{is}})}{WC_{\text{is}} + 100}$$

Sample preparation:

- Weighing of 21 x 0,50 g each sample (3 parallel test specimens for 6 measure time points and 3 sterile controls)
- Insertion of samples into net bag
- Determination of total weight each sample

Soil-burial:

- Burying of 3 test specimens each sample in approx. 1 l soil in 1 l screw cap glasses
- steam pressure sterilization of the sterile controls 3 x for 30 min. at 121 °C
- Storage at 29 °C and min. 70 % relative humidity

Recovery of samples & gravimetric analysis

- Digging up of samples
- Desinfection through soaking in 70% ethanol for 5 min.
- Washing of samples under running water
- Drying of samples at 70 °C and adjacent conditioning at room temperature
- Gravimetric analysis of samples acc.:

$$\text{Residual mass (t)} = \frac{m_{\text{sample+net}}(t) - MW m_{\text{NC}}(t)}{MW m_{\text{sample+net,t0}} - MW m_{\text{NC,t0}}}$$

3. Test results

Test results are shown in table 1, pictures and figure 1.

Table 1: Weight of samples after soil-burial

sample no.	3019		3020		3021	
	time [d]	mass [%]	stand. dev.	mass [%]	stand. dev.	mass [%]
0	100,0	0,0	100,0	0,0	100,0	0,0
6	93,9	2,1	84,3	5,8	87,8	6,1
14	82,9	1,6	36,7	10,7	28,7	32,6
20	93,3	4,3	21,4	4,5	44,2	20,5
24	74,4	12,3	-6,7	12,6	17,3	13,8
31	27,0	37,9	-2,4	8,8	n.d.	-
41	48,9	26,0	n.d.	-	n.d.	-



Samples before soil-burial



samples in soil



3019 after 6 days soil-burial



3019 after 41 days soil-burial



3020 after 6 days soil-burial



3020 after 41 days soil-burial



3021 after 6 days soil-burial



3021 after 41 days soil-burial



Sterile control 3019



Sterile control 3020



Sterile control 3021

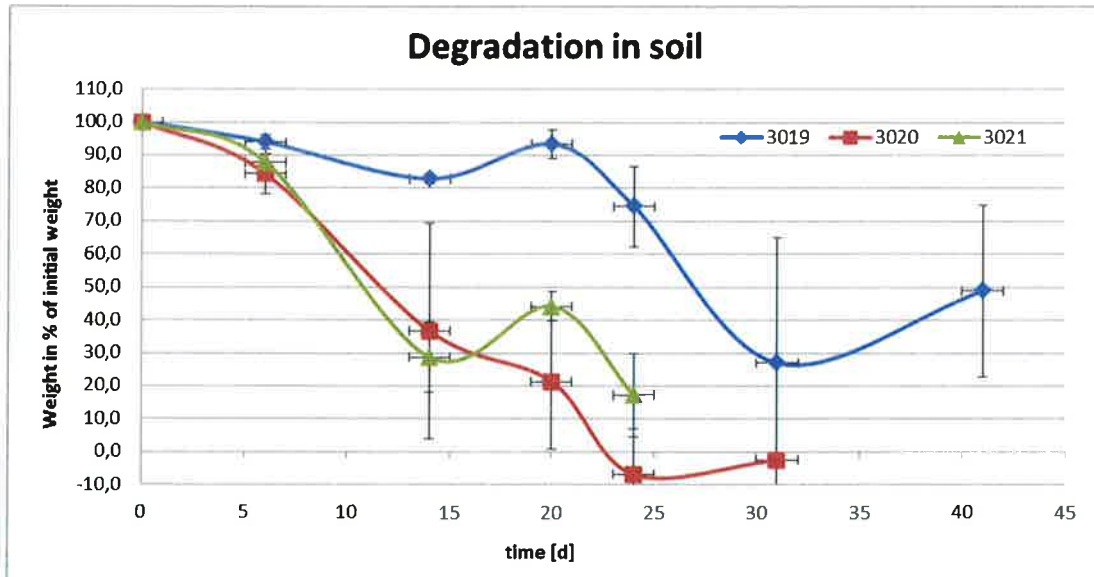


Figure 1: Weight of samples after soil-burial in % of initial weight

4. Assessment

After 41 days of soil-burial sample „smartcel sensitive 1703024“ (3019) shows a degradation rate of 48,9% ($\pm 26\%$). Therefore, a period of approx. 80 days can be estimated until complete degradation of the fiber sample.

In contrast, samples „SeaCell LT 1703022“ (3020) and „SeaCell MT 1703023“ (3021) show more rapid degradation. Sample „SeaCell LT 1703022“ (3020) is almost completely degraded after 41 days soil-burial and sample „SeaCell MT 1703023“ (3021) shows a reduction to 17,3% ($\pm 13,8\%$) of the initial weight after 24 days and is nearly completely degraded after 31 days.



Dr. J. Bauer
Head of laboratory biology
Dept. Plastic-Research

