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# Quinorgan S.L

C09.1021

**Offer number**

VOFE004380

**Project number**

P21-0737

**Laboratory**

Compostability

**Test report no.**

C09.1021

**Requested by**

Quinorgan S.L

C/ Fresser 21-23 Montcada I Reaixac 0810 Barcelona

**Contact person**

Rubén Ruiz

**Received on**

June 28th 2021

**Start date**

July 7th 2021

**End date**

October 25th 2021

**Prepared by**

Jaime González

**Sample**

DIANA BIO

Laboratory recognized by:



## Tests

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- Determination of the regulated metals (Zn, Cu, Ni, Cd, Pb, Hg, Cr, Mo, Se, As, Co) and hazardous substances (F) in test material according to the requirements established in UNE-EN 13432:2001.
- Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test according to requirements established in UNE-EN 13432:2001 and following the technical procedure detailed in ISO 16929:2019<sup>1</sup>.

## Equipment

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Characterization of test material and bio-waste

- EC04/ITN Compostability balance
- EC13/ITN Muffle
- EC16/ITN Thermocouple Probe
- EC17/ITN Soil Moisture Measurement Kit
- EC18/ITN Direct soil pH measurement kit
- EC19/ITN Drying oven
- EC23/ITN Dewar bottle
- E09/ITN Electronic balance
- E17/ITN Climate chamber
- E106/ITN Digital Micrometer
- E81/ITN or E103/ITN cutting template
- EC40/ITN Analytical balance

Disintegration ISO 16929

- EC05/ITN Perforated Sieves
- EC09/ITN Disintegration system
- EC24/ITN O2 analyser
- EC25/ITN Automatic temperature acquisition system
- EC35/ITN Disintegration System No. 2
- EC36/ITN Automatic temperature acquisition system No. 2

## Sample ID

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Diana Bio (internal Ref: P21-0737-01)

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<sup>1</sup> Compost quality is not required



## Requirements for packaging recoverable through composting and biodegradation

According to UNE-EN 13432:2001

Table 1. Evaluation of conformity.

### General data and test specifications

Sample code: P21-0737-01 Technical procedure: PT-04-58, PT-04-60 and PT-04-63

### Final result of the evaluation for recovery through composting and biodegradation

Evaluation file reference: Accepted

Test sample	Characterization	Biodegradability	Disintegration	Final quality of compost
P21-0737-01	Required	No Required	Required	No Required

### Compostability test summary results

		Thickness, $\mu\text{m}$ (Mean $\pm$ SD)	1287.80 $\pm$ 8.95
		Grammage, g/m <sup>2</sup> (Mean $\pm$ SD)	1194.19 $\pm$ 22.76
Test sample	Characterization	Volatile solids, % (Mean $\pm$ SD)	99.80 $\pm$ 0.09
	Heavy metals and dangerous substances		Table 2
Disintegration degree	Disintegration degree of the test material.	Mean of the replicates, %	100

Has been the test material previously tested with a higher thickness or mass/surface?

See file No. No

Have been minor changes that do not affect the compliance with the standard made?

No

### Observations:

Disintegration meets the success criteria set out in EN13432:2001. After 84 days, the disintegration degree of the material is 100 %, more than 90 % required by the standard.

Data provided by the customer:

Name of the sample: Diana Bio

## Characterization of test sample

According to UNE EN 13432:2001, UNE-EN ISO 14855-1:2013, ISO 16929:2021

## Form, thickness, properties, and visual appearance

### Physico-chemical properties

Table 2. Form and thickness of test sample.

Form	Film	Thickness (Mean $\pm$ SD), $\mu\text{m}$	1287.80 $\pm$ 8.95
Dry solids, %	96.92 $\pm$ 0.03	Thickness (Mean $\pm$ SD), $\mu\text{m}$	N.A.
Volatile solids, %	99.80 $\pm$ 0.03	Thickness (Mean $\pm$ SD), $\mu\text{m}$	N.A.
Grammage, g/m <sup>2</sup>	1194.19 $\pm$ 22.76	Is the volatile solids content > 50%?	Yes

### Heavy metals and dangerous substances<sup>2</sup>

Equipment	IPC-MS Agilent 7700x	
Analyte	Value (mg/Kg) <sup>1</sup>	Legal limit (mg/Kg)
Cr	0.01	50
Ni	0.02	25
Cu	0.38	50
Zn	3.13	150
As	0.04	5
Se	<0.01	0,75
Mo	0.08	1
Cd	<0.01	0,5
Hg	<0.01	0,5
Pb	0.01	50
Co <sup>3</sup>	<0.01	38
F	13.627	100

<sup>2</sup> Data provided by external supplier

<sup>3</sup> Maximum level for Canada (CAN/BNQ 0017-088 (2010)) = 38 mg/Kg on Total Solids

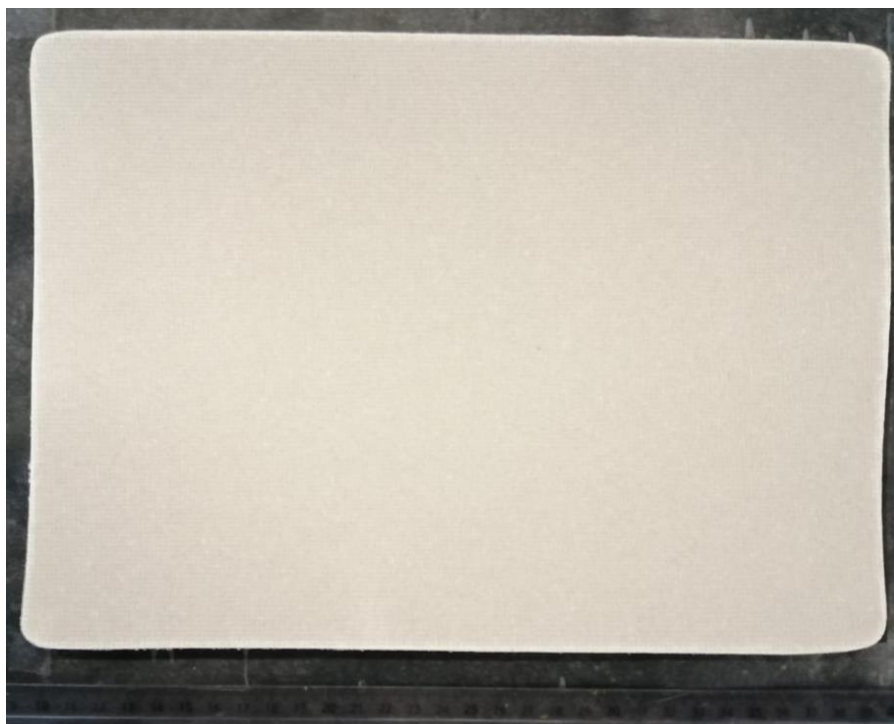


Figure 1. Visual aspect of the test sample in its final form

## Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test

According to ISO 16929:2019

### Biowaste properties

Table 3. Information and properties of the biowaste.

#### Composition of the artificial biowaste

	Wet weight (kg)
Mature compost:	10
Freshly mixed fruit and vegetables waste:	9
Rabbit feed:	1
Bulking agent:	5
Water:	5

#### Physico-chemical properties of the artificial biowaste

Bulking agent percentage, %	16,67	Is the bulking agent between 10% and 60% of the total biowaste and with a size between 10 and 50 mm?	Yes
C/N ratio <sup>1</sup> :	20,31	Is C/N ratio of the fresh biowaste/bulking agent mixture between 20 and 30?	Yes
Dry solids, %:	34,33	Is moisture content > 50%, with no free water present?	Yes
Volatile solids, %:	65,87	Is volatile solids content > 50% of the total dry solids?	Yes
pH:	6,34	Is pH > 5?	Yes

### Test conditions

Table 4. Disintegration test conditions.

#### Biowaste / Test sample

Blank reactor	Wet weight (kg)
Biowaste:	30
Total weight:	30
Test sample reactor	Wet weight (kg)
Biowaste:	30
Test material in its final form:	0,3
Test material in powder:	-
Total weight:	30,3

### Test requirements

Is the wet weight > 15 kg in each composting reactor and similar between them?	Yes
Is the test material > 1% on wet weight basis in its final form?	Yes
Is the ecotoxicity test conducted? No	Moreover, is the test material > 9% on wet weight as powder or granules? No



### Description of the composting reactors

Composting reactors: High-density polyethylene bins with a volume 65 L or higher . Air inlet is introduced in the bottom of the reactor and air outlet is situated at the top. The drainage consists of a layer of a drainage material with a thickness of 10 cm at the bottom of the reactor and a valve that allows the extraction of the lixivate generated during the composting process.

Replicates:	Tests performed:	Disintegration,
Turning and test duration:	84 days	

Reactor type	Reactor identification
Blank replicate 1	EC35-01/ITN
Blank replicate 2	EC35-02/ITN
Test sample replicate 1	EC35-30/ITN
Test sample replicate 2	EC35-31/ITN

## Composting process

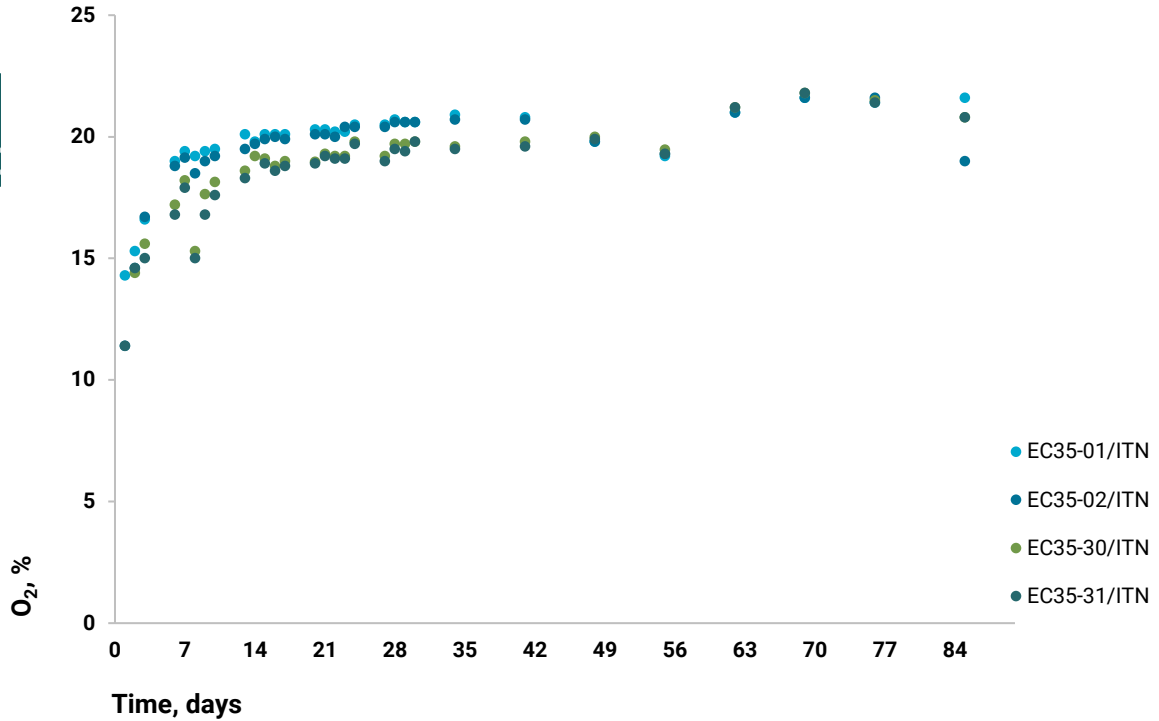


Figure 2. Evolution of oxygen concentration in the composting reactors.

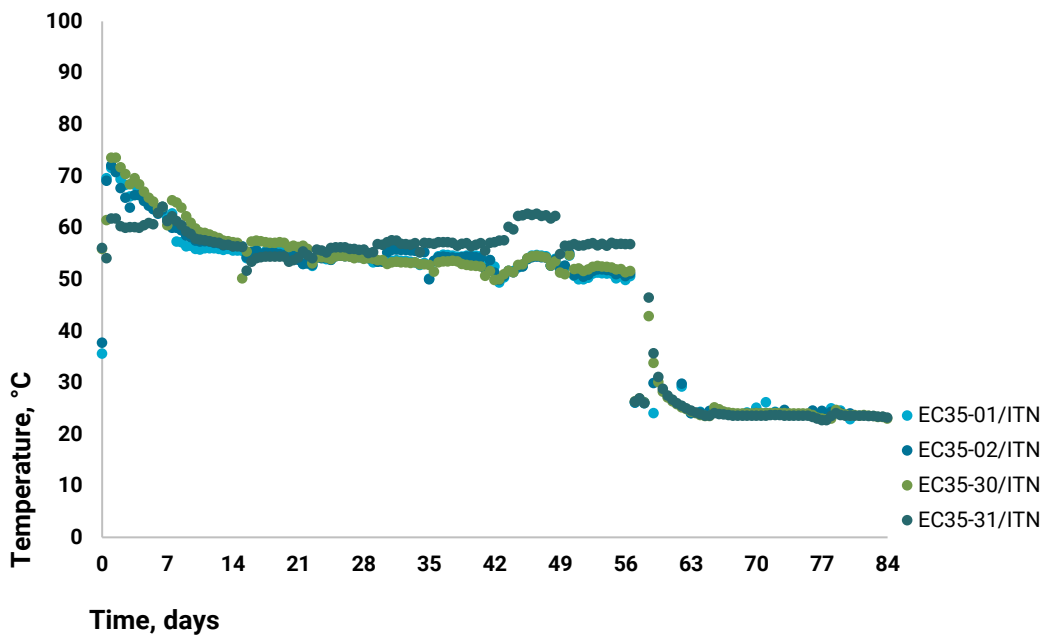


Figure 3. Evolution of temperature in the composting reactors.



Table 5. Evolution of temperature in the composting reactors. Means values.

Time, days	Blank reactor 1, °C	Blank reactor 2, °C	Test material reactor 1, °C	Test material reactor 2, °C
0,0	35,6	37,7	55,9	56,1
0,5	69,6	69,1	61,5	54,1
1,0	71,6	72,1	73,6	61,8
1,5	71,2	70,8	73,6	61,8
2,0	69,4	67,7	71,7	60,3
2,5	68,3	65,8	70,4	60,0
3,0	66,1	63,9	68,4	60,1
3,5	68,3	66,3	69,6	60,1
4,0	67,0	66,3	68,4	60,0
4,5	65,8	65,2	67,0	60,5
5,0	64,9	64,3	65,8	60,9
5,5	64,2	63,6	65,1	60,7
6,0	63,0	62,7	63,7	62,9
6,5	64,0	63,5	64,0	64,1
7,0	62,0	61,5	60,5	61,3
7,5	62,8	60,0	65,3	62,2
8,0	57,3	60,0	64,9	61,3
8,5	57,2	59,5	63,9	60,5
9,0	56,4	58,5	62,2	59,3
9,5	56,5	58,2	61,0	58,8
10,0	55,9	57,5	59,9	57,9
10,5	55,8	57,3	59,1	57,7
11,0	56,0	57,4	59,0	57,6
11,5	56,0	57,3	58,7	57,4
12,0	56,0	57,1	58,3	57,2
12,5	55,9	57,0	58,0	57,1
13,0	55,7	56,6	57,5	56,7
13,5	55,9	56,7	57,4	56,7
14,0	55,6	56,4	57,2	56,4
14,5	55,6	56,5	57,1	56,4
15,0	55,5	56,4	50,2	56,3
15,5	54,1	54,3	55,4	51,7
16,0	55,2	55,3	57,3	53,4
16,5	55,7	55,6	57,5	54,1
17,0	54,9	54,9	57,4	54,3
17,5	55,4	55,2	57,2	54,4
18,0	55,5	55,2	57,1	54,4
18,5	55,5	55,1	57,1	54,4
19,0	55,4	54,9	57,2	54,4
19,5	55,3	54,7	57,1	54,4
20,0	54,2	53,6	56,3	53,4
20,5	55,2	54,7	56,5	53,7
21,0	54,2	53,8	56,3	54,2
21,5	53,0	53,0	56,5	55,4
22,0	53,1	53,1	55,9	54,7
22,5	52,6	52,8	53,1	54,1
23,0	54,4	54,2	54,2	55,8
23,5	54,4	54,1	54,3	55,6
24,0	53,9	54,2	54,2	55,2
24,5	53,8	53,8	53,9	56,1



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25,0	54,7	54,5	54,5	56,2
25,5	54,9	54,6	54,6	56,2
26,0	54,8	54,5	54,5	56,2
26,5	54,7	54,5	54,4	55,9
27,0	54,4	54,3	54,1	55,9
27,5	54,5	54,3	54,3	55,7
28,0	54,1	54,2	54,0	55,8
28,5	54,2	54,1	54,1	55,1
29,0	53,3	54,2	54,0	55,3
29,5	53,4	53,4	53,7	56,8
30,0	53,5	53,4	53,7	56,7
30,5	53,2	55,2	53,0	57,2
31,0	53,6	55,7	53,3	57,6
31,5	53,7	55,8	53,4	57,5
32,0	53,6	55,7	53,3	56,9
32,5	53,6	55,7	53,3	56,8
33,0	53,4	55,6	53,2	56,7
33,5	53,3	55,5	53,3	57,0
34,0	52,8	55,2	52,9	55,3
34,5	53,2	55,3	52,9	57,1
35,0	50,1	50,0	52,8	57,0
35,5	53,5	53,6	51,5	56,9
36,0	54,5	54,3	53,3	57,2
36,5	54,8	54,4	53,5	57,2
37,0	54,7	54,3	53,5	57,2
37,5	54,6	54,2	53,6	57,1
38,0	54,4	54,1	53,5	56,5
38,5	54,4	54,3	53,0	56,9
39,0	54,6	54,4	52,8	57,0
39,5	54,6	54,4	52,7	56,4
40,0	54,6	54,3	52,6	56,7
40,5	54,5	54,2	52,5	57,0
41,0	53,1	52,0	50,7	55,6
41,5	53,7	53,7	51,6	57,1
42,0	52,5	51,3	49,9	57,2
42,5	49,4	49,9	50,0	57,5
43,0	50,4	50,7	51,0	57,6
43,5	51,6	51,6	51,7	60,2
44,0	51,6	51,4	51,4	59,7
44,5	52,3	52,4	52,8	62,3
45,0	52,6	52,5	52,9	62,4
45,5	54,0	53,9	54,1	62,7
46,0	54,6	54,3	54,5	62,5
46,5	54,7	54,4	54,6	62,7
47,0	54,6	54,3	54,4	62,3
47,5	54,5	54,2	54,2	62,4
48,0	52,7	52,7	52,7	61,8
48,5	54,0	53,8	53,5	62,3
49,0	52,5	52,0	51,3	54,9
49,5	52,3	52,7	51,0	56,5
50,0	54,6	55,1	54,7	56,5
50,5	50,7	50,8	52,0	56,8
51,0	50,0	51,2	52,1	56,5

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51,5	50,0	50,5	51,6	56,6
52,0	50,3	50,9	51,9	56,8
52,5	51,1	51,6	52,4	57,0
53,0	51,3	51,9	52,6	56,6
53,5	51,2	51,9	52,5	56,9
54,0	51,1	51,8	52,4	56,5
54,5	51,1	51,7	52,3	57,1
55,0	50,2	51,0	51,9	56,8
55,5	50,6	51,3	52,0	56,9
56,0	49,9	50,6	51,4	56,8
56,5	50,6	51,1	51,6	56,8
57,0	26,1	26,1	26,4	26,3
57,5			26,9	26,9
58,0	26,0	26,2	26,1	26,0
58,5			42,9	46,5
59,0	24,1	29,9	33,8	35,7
59,5			30,1	31,1
60,0			28,2	28,8
60,5			27,1	27,5
61,0			26,4	26,7
61,5			25,8	26,0
62,0	29,2	29,8	25,2	25,5
62,5			24,9	25,0
63,0	24,1	24,1	24,4	24,6
63,5			24,1	24,2
64,0	24,3	24,2	23,7	23,9
64,5			23,5	23,6
65,0	24,3	24,5	23,5	23,6
65,5			25,2	24,1
66,0	24,6	24,6	24,8	23,9
66,5			24,4	23,8
67,0			24,2	23,7
67,5			24,1	23,6
68,0			24,0	23,6
68,5			24,0	23,6
69,0	24,2	24,0	24,0	23,6
69,5			24,0	23,6
70,0	25,1	24,1	24,1	23,6
70,5			24,1	23,6
71,0	26,2	24,1	24,1	23,6
71,5			24,1	23,7
72,0	24,3	24,2	24,1	23,7
72,5			24,1	23,7
73,0	24,2	24,7	24,1	23,6
73,5			24,0	23,6
74,0			24,0	23,6
74,5			24,0	23,6
75,0			24,0	23,6
75,5			24,0	23,6
76,0	24,0	24,6	23,7	23,3
76,5			23,2	23,0
77,0	24,1	24,5	23,0	22,7
77,5			22,9	22,7

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78,0	25,0	24,3	23,0	23,5
78,5			24,7	24,1
79,0	24,6	24,2	24,0	23,7
79,5			23,8	23,6
80,0	22,9	24,0	23,6	23,6
80,5			23,7	23,6
81,0			23,6	23,6
81,5			23,7	23,6
82,0			23,6	23,5
82,5			23,5	23,5
83,0			23,3	23,4
83,5			23,3	23,4
84,0			23,0	23,2

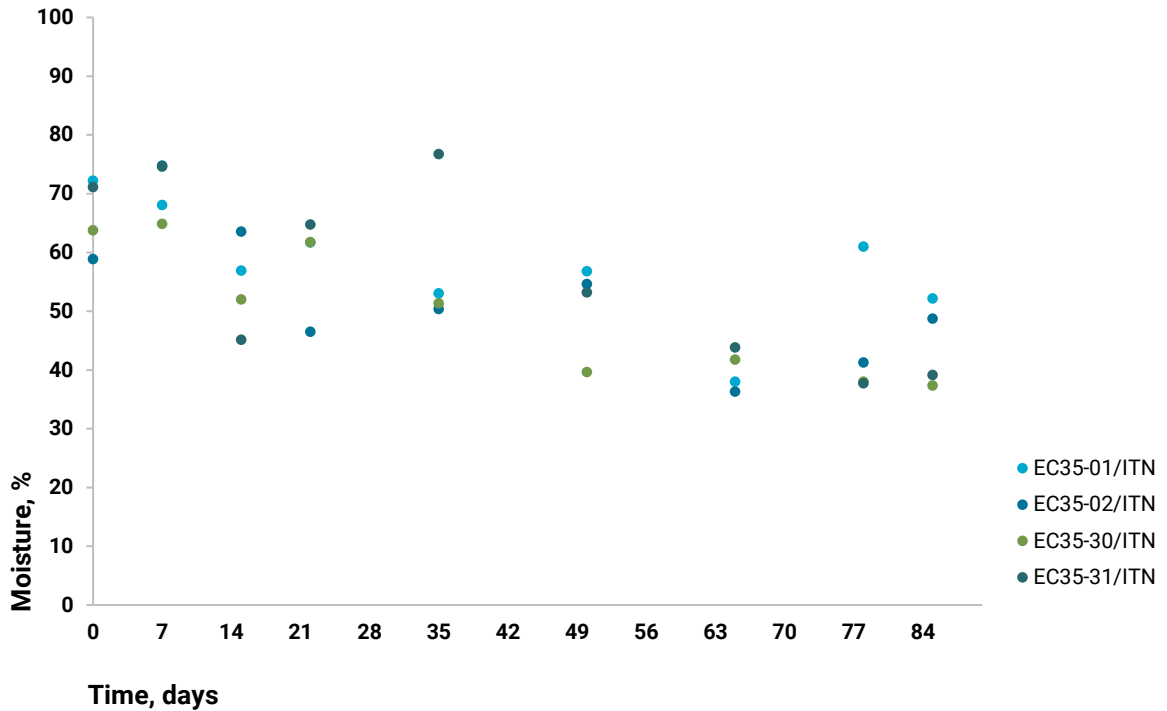


Figure 4. Evolution of moisture in the composting reactors.

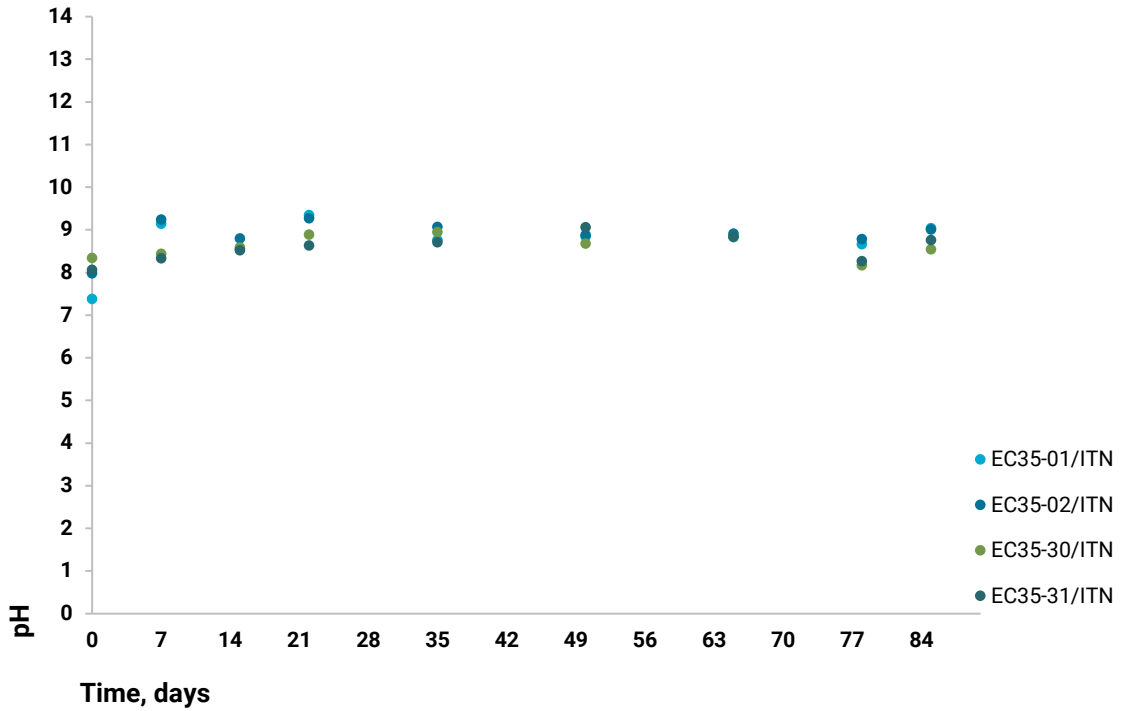


Figure 5. Evolution of pH in the composting reactors.

### Disintegration degree

Table 6. Disintegration degree of the test material.

	Reactor	Reactor 2
Weight of total dry solids in the test material input, g	300,00	300,00
Weight of total dry solids in the retrieved test material > 2 mm, g	0	0
Di, %	100	100

### Visual observations

Table 7. Visual observations.

Parameter	Observations
Consistency and compactness material	
Decolorization	
Signs of local disintegration	
Easiness of retrieving	
Is there visual contamination?	There isn't visual contamination

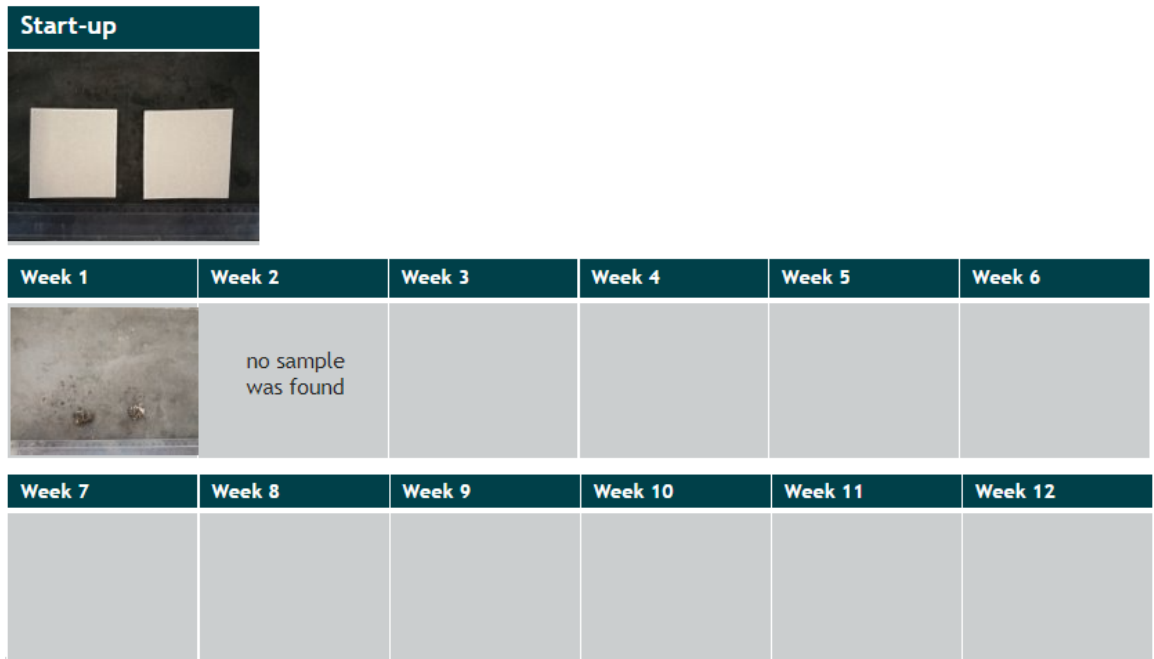


Figure 6. Appearance of the test material during the test

## Maturity test – Rottegrad

Table 8. Assignment of maturity level to blank compost using Rottegrad scale after 12 weeks in composting conditions.

Test data			
Humidity, %	50,0		
Initial temperature, °C	23,47	$\Delta T$ , °C	2,97
Final temperature, °C	26,43	Rottegrad level:	V

## Test validity

Table 9. Validity criteria of the disintegration test.

Validity criteria	Compliance
The temperature regime as described in 6.2.2.3 has been respected?	Yes
Does the pH increase to a value > 7 during the test and does not fall < 5?	Yes
Has the blank compost a maturity (Rottegrad) of IV or V after 12 weeks?	Yes
Test validity	Yes

## Observations:

**Test report no.:** C09.1021  
**Offer number:** VOFE004380  
**Laboratory:** Compostability



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## General observations

Disintegration meets the success criteria set out in EN13432:2001. After 84 days, the disintegration degree of the material is 100 %, more than 90 % required by the standard.



**Test report no.:** C09.1021  
**Offer number:** VOFE004380  
**Laboratory:** Compostability



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Paterna (Valencia), October 27th 2021

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