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GUANGDONG DETECTION CENTER OF MICROBIOLOGY

REPORT FOR ANALYSIS

Report №. 2025ESQ00087R01E

Name of Sample Biodegradable Bamboo Fibric Materials

Applicant Fujian Yangzhu New Material Technology Co., Ltd

Test Type Entrustment Test

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GUANGDONG DETECTION CENTER OF MICROBIOLOGY

REPORT FOR ANALYSIS

Report №. 2025ESQ00087R01E Verification Code: WFCJ87HF

Name of Sample	Biodegradable Bamboo Fibric Materials	Test Type	Entrustment Test
Applicant	Fujian Yangzhu New Material Technology Co., Ltd	Address	No. 19, Penghu Town Industrial Park, Yongchun County 362600 QUANZHOU, FUJIAN PROVINCE CHINA
Sample Source	Submitted for Testing by the Applicant	Sample Quantity	8 kg
Spec and Lot № of Sample	——	State and Characteristic	Solid
Sample Received Date	2025-02-21	Test Completion Date	2025-08-05
Item Tested	Thickness, grammage, heavy metals and other toxic and hazardous substances, volatile solids content, disintegration, ecotoxicity		
Test Standard and Method	EN 13432: 2000 Packaging - Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging ASTM D6400-2023 Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities AS 4736-2006 Biodegradable plastics - Biodegradable plastics suitable for composting and other microbial treatment ISO 16929: 2021 Plastics - Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test OECD TG 208: 2006 Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test ASTM E1676-12 (2021) Standard Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm *Eisenia Fetida* and the Enchytraeid Potworm *Enchytraeus albidus* ISO 536:2019 Paper and board - Determination of grammage ISO 4593:1993 Plastics - Film and sheeting - Determination of thickness by mechanical scanning		
Test Conclusion	Under the current conditions, the test results confirmed that the test material met the requirements for heavy metals, cobalt, fluorine, volatile solids content, disintegration and ecotoxicity (terrestrial plant) as outlined in EN 13432:2000, ASTM D6400-2023 and AS 4736-2006. In addition, the result of the earthworm acute toxicity test met the requirement of AS 4736-2006. Comprehensive details of these findings are presented in the main text. Issue Date: 2025-08-05 (Official Seal)		
Remarks			

Editor: Lv zi yi **Verifier:** Deng Guirong

Auditor: Liang Yanzhen **Approver:** Mei Chengfang

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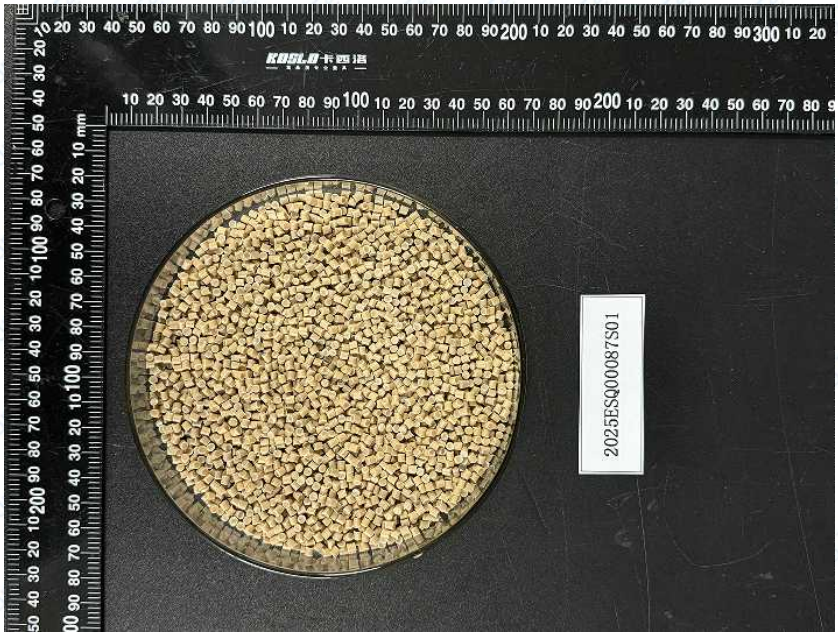
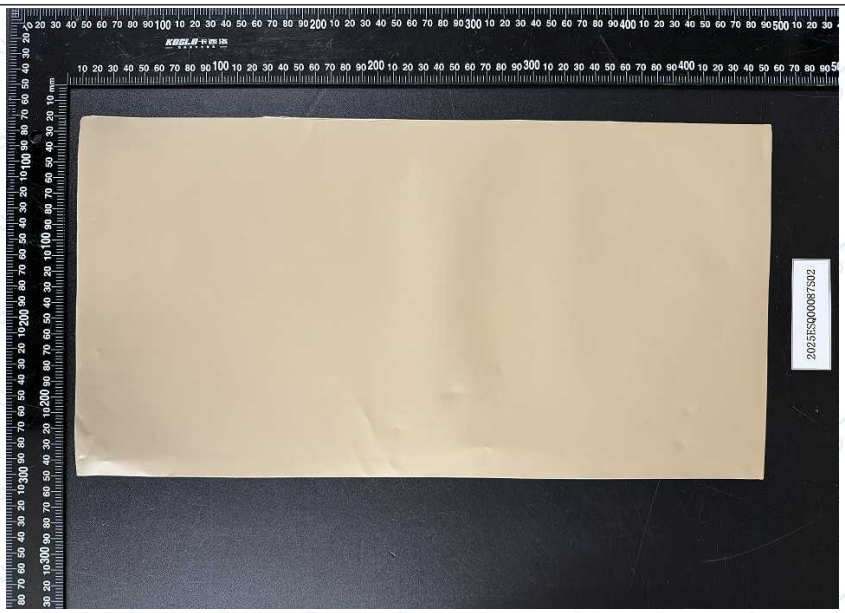
GUANGDONG DETECTION CENTER OF MICROBIOLOGY ANALYSIS AND TEST RESULT

Report №. 2025ESQ00087R01E

1 Appearance and identification of test material

1.1 Appearance of test material

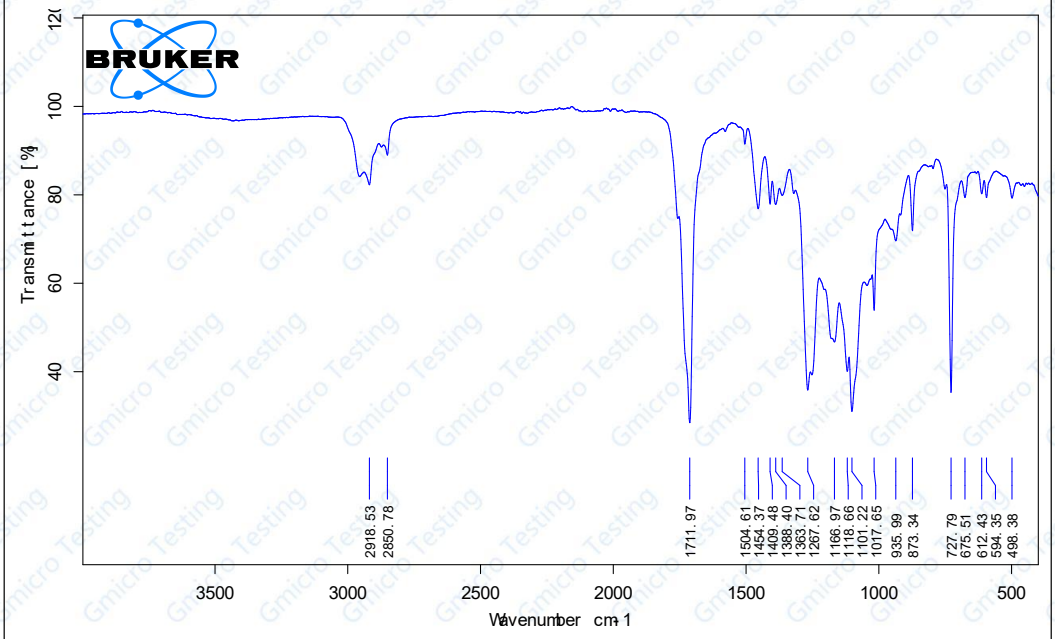
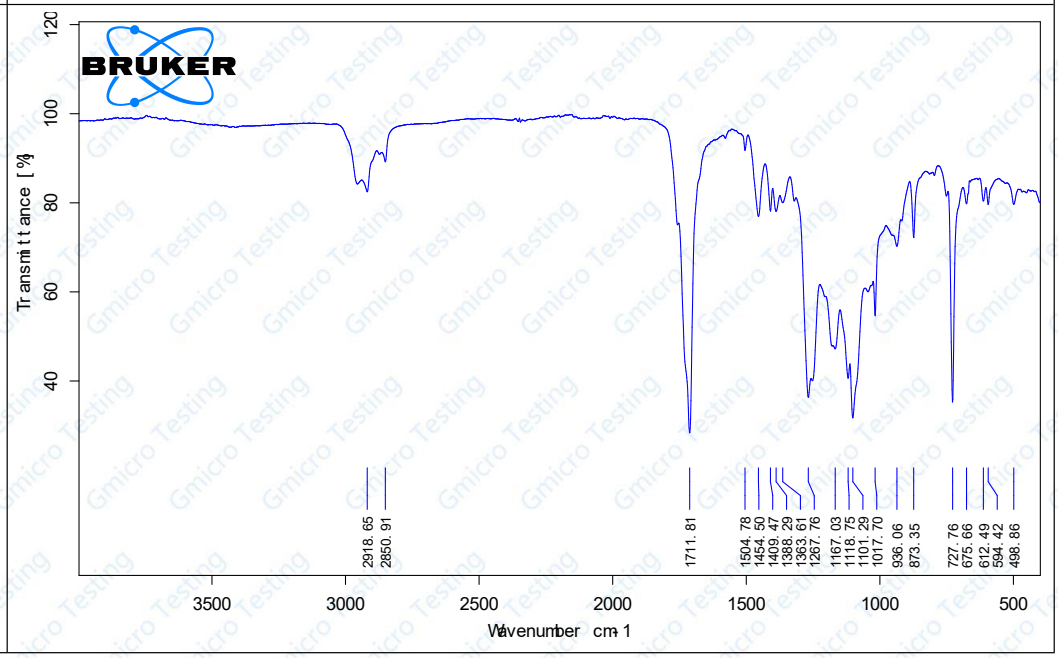
Table 1-1 Appearance of test material

Test material	Appearance of test material
Biodegradable Bamboo Fibric Materials (S01)	
Biodegradable Bamboo Fibric Materials (S02)	

Report №. 2025ESQ00087R01E

1.2 Identification of test material

Table 1-2 FTIR of test material

Test material	FTIR
Biodegradable Bamboo Fibric Materials (S01)	
Biodegradable Bamboo Fibric Materials (S02)	

(Brought down)

2 Thickness and grammage of test material

The thickness and grammage of test material were measured on Biodegradable Bamboo Fibric Materials (S02) based on ISO 4593: 1993 and ISO 536: 2019 respectively. Results are shown in Table 2-1 and Table 2-2.

Table 2-1 Thickness of Biodegradable Bamboo Fibric Materials (S02)

Measurement point	Thickness (mm)	Maximum (mm)	Minimum (mm)	Average (mm)	Standard deviation (mm)
1	0.2642	0.275	0.231	0.253	0.013
2	0.2610				
3	0.2358				
4	0.2680				
5	0.2568				
6	0.2328				
7	0.2746				
8	0.2688				
9	0.2578				
10	0.2560				
11	0.2576				
12	0.2672				
13	0.2350				
14	0.2670				
15	0.2588				
16	0.2306				
17	0.2524				
18	0.2492				
19	0.2680				
20	0.2502				
21	0.2588				
22	0.2478				
23	0.2364				
24	0.2340				
25	0.2420				
26	0.2698				
27	0.2528				
28	0.2420				
29	0.2504				
30	0.2486				

(Brought down)

Table 2-2 Grammage of Biodegradable Bamboo Fibric Materials (S02)

Measurement point	Grammage (g/m^2)	Maximum (g/m^2)	Minimum (g/m^2)	Average (g/m^2)	Standard deviation (g/m^2)
1	286	292	283	288	2
2	288				
3	288				
4	288				
5	292				
6	287				
7	288				
8	290				
9	287				
10	283				

(Brought down)

3 Volatile solids content

The test result shown that the volatile solids content of Biodegradable Bamboo Fibric Materials (S01) met the requirements of EN 13432:2000, ASTM D6400-2023 and AS 4736-2006. Results are shown in Table 3-1.

Table 3-1 Volatile solids content

Requirements of EN 13432:2000, ASTM D6400-2023 and AS 4736-2006	Test result	Conclusion
≥ 50%	96.8%	Pass

4 Heavy metals and other toxic and hazardous substances

Heavy metals of test material were measured on Biodegradable Bamboo Fibric Materials (S01) using Inductively Coupled Plasma Mass Spectrometry (ICP-MS), while fluoride was measured using Ion Chromatography (IC). Test results have confirmed that the contents of heavy metals, cobalt and fluorine in the test material are in accordance with the requirements outlined in EN 13432:2000, ASTM D6400-2023 and AS 4736-2006. The results are shown in Table 4-1.

Table 4-1 Results of heavy metals and fluorine content

Element	Requirement of EN 13432: 2000 and AS 4736-2006 (mg/kg on dry substance)	Requirement of ASTM D6400-2023 (mg/kg on dry substance)			LOD [c] (mg/kg on dry substance)	Test result (mg/kg on dry substance)	Conclusion
		USA [a]	Canada [b]				
			CCME	Ontario			
Zn	150	1400	350	250	0.2	4.5	Pass
Cu	50	750	200	50	0.1	1.0	Pass
Ni	25.0	210	31	31	0.1	0.2	Pass
Cd	0.5	17	1.5	1.5	0.01	0.01	Pass
Pb	50	150	75	75	0.1	0.5	Pass
Hg	0.5	8.5	0.4	0.4	0.01	< 0.01	Pass
Cr	50	—	105	105	0.1	2.3	Pass
Mo	1	—	2.5	2.5	0.1	< 0.1	Pass
Se	0.75	50	1	1	0.1	< 0.1	Pass
As	5	20.5	6.5	6.5	0.1	0.1	Pass
Co	—	—	17	17	0.1	< 0.1	Pass
F	100	—	—	—	2	27	Pass

Note:

[a] The requirement given here for the USA are 50% of those prescribed by 40 CFR 503.13, Table 3 (as described in ASTM D6400-2023).

[b] The requirement for Canada is 50% of those prescribed in Table 1 for Compost Category A in Guidelines for Compost Quality published by the Canadian Council of Ministers of the Environment (CCME), and Category AA in Table 3.1 of the Ontario Compost Quality Standard, published by Ontario Ministry of the Environment (as described in ASTM D6400-2023).

[c] Means limit of detection.

5 Disintegration

5.1 Test method

The disintegration test was conducted on Biodegradable Bamboo Fibric Materials (S02) based on ISO 16929: 2021.

5.2 Test system

5.2.1 Characteristics of test material and biowaste

Table 5-1 Characteristics of test material and biowaste

Material / Index	Test material	Biowaste
Name	Biodegradable Bamboo Fibric Materials	Biowaste
Source	Applicant	Self-made in laboratory
Visual appearance	Brown film	Brown granular
Preparation	For the disintegration test, the test material was cut into pieces measuring 10 cm × 10 cm; for ecotoxicity test, the test material was crushed into a powdery form using liquid nitrogen	The biowaste was prepared by mixing 51.5% freshly mixed fruit and vegetable waste, 2.5% rabbit feed, 5.0% mature compost, 10% wood chips and 31% soil, all components were reduced to particle sizes of maximum 50 mm
pH value	—	5.54 (≥ 5)
Moisture content (%)	0.5	57.4 (≥ 50)
Total dry solids content (%)	99.5	42.6
Volatile solids content (%)	96.8	73.4 (≥ 50)
Total organic carbon (%)	60.1 (based on dry mass)	30.8 (based on dry mass)
Total nitrogen content (g/g)	7.66×10^{-4} (based on dry mass)	1.11×10^{-2} (based on dry mass)
Ratio of carbon to total nitrogen (C/N)	—	27.7 (within 20 - 30)

Note: "—" means no need for measurement.

(Brought down)

5.2.2 Instrument

Name	Bio-composting climate box
Composting vessel	Compost bin
Volume	40 L / bin

5.3 Test design

One blank control and one test group were set in the test, two replicates for each group. Biowaste and test material were weighed and mixed well according to Table 5-2, then the mixtures were transferred to compost bins and the test was started.

Table 5-2 Preparation of test system

Group	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Biowaste (kg)	17.024	17.018	17.021	17.016
Test material in the form of 10 cm × 10 cm (g)	—	—	170.7	171.9
Test material in powder form (g)	—	—	1536.4	1530.2
Total weight (kg)	17.024	17.018	18.728	18.718

Note: "—" means no test material was added.

5.4 Process and measurement

Turning of compost was conducted weekly during the first 4 weeks, and then every 2 weeks until the end of the test. The measurement of pH and moisture contents for each replicate were conducted simultaneously with the turning. Internal temperatures of each compost bin were recorded every working day. The oxygen concentrations of each compost bin were measured every working day during the first month and at least once a week afterwards. At the end of the test, all compost was sieved with 10 mm and 2 mm sieves in sequence, all particles of test material were picked out from 10 mm and 2 mm fraction thus obtained. After cleaning with deionized water, the particles of test material were dried to a constant mass for the calculation of degree of disintegration.

5.5 Calculation

The degree of disintegration of the test material was calculated based on the equation below:

$$D_i = \frac{m_1 - m_2}{m_1} \times 100$$

where

D_i is the degree of disintegration of the test material, expressed in per cent (%);

m_1 is the mass of total dry solids in the test material input, expressed in grams (g);

m_2 is the mass of total dry solids in the retrieved test material, expressed in grams (g).

(Brought down)

5.6 Test results

5.6.1 Temperature

1) Internal temperature of compost in each compost bin

The temperature of composting material during the test met the validity requirement of test standard. Results are shown in Table 5-3 and Figure 5-1.

Table 5-3 Internal temperature of compost during the test (℃)

Time (d)	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
1	58.6	58.7	57.7	62.5
2	63.5	64.2	62.7	63.9
5	64.2	65.6	64.7	65.0
6	63.2	62.5	63.2	63.3
7	62.1	61.7	61.7	62.6
8	60.9	61.0	60.9	61.1
9	61.7	62.1	61.9	60.4
12	58.6	58.9	60.7	58.3
13	57.9	57.4	58.8	57.6
14	57.0	57.3	58.1	57.5
15	56.6	57.1	58.6	57.2
16	56.0	58.3	59.0	57.3
19	56.8	57.2	59.6	56.7
20	55.9	56.1	59.8	56.5
21	55.5	55.8	59.0	56.3
22	55.2	55.9	58.9	56.1
23	54.9	56.2	58.2	56.5
26	55.2	55.1	58.0	56.7
27	54.7	55.6	57.7	56.8
28	54.3	55.0	55.3	54.9
29	54.2	54.5	55.0	55.2
30	54.5	54.9	55.1	55.3
33	54.8	54.0	57.3	57.2
34	53.7	54.3	57.5	57.8
35	53.2	54.2	57.2	57.7
36	52.6	53.7	55.2	55.2
37	53.0	53.5	55.5	55.0
40	52.6	53.6	54.2	55.3

(Brought down)

Continued Table 5-3 Internal temperature of compost during the test (℃)

Time (d)	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
41	52.7	53.7	53.7	55.5
42	51.8	52.3	53.9	54.8
43	51.1	52.6	53.2	54.2
44	51.4	51.5	53.1	54.0
47	50.6	51.8	54.5	55.1
48	51.3	52.0	53.8	54.3
49	50.7	52.0	51.6	53.2
50	50.5	51.5	50.4	52.5
51	50.2	50.6	51.5	51.6
54	50.0	49.3	50.2	50.8
55	49.2	49.0	50.0	49.8
56	49.0	48.5	49.5	49.6
57	49.8	48.2	49.2	49.3
58	48.8	48.7	48.4	49.5
60	47.6	48.5	47.5	49.3
61	46.5	48.2	47.0	49.0
62	46.8	47.7	46.2	48.8
63	46.5	46.3	44.5	46.3
69	43.6	44.5	43.7	45.9
70	43.3	44.5	43.6	45.2
71	42.7	43.8	41.7	44.5
72	42.9	42.6	40.2	44.4
75	41.6	41.4	40.8	44.6
76	42.3	41.3	40.3	44.0
77	41.9	40.5	37.2	39.3
78	40.3	40.0	38.2	40.4
79	40.2	39.8	38.0	40.0
82	37.5	38.8	36.7	38.8
83	36.4	37.3	36.5	38.2
84	36.2	35.9	36.5	37.9

(Brought down)

2) Temperature profile

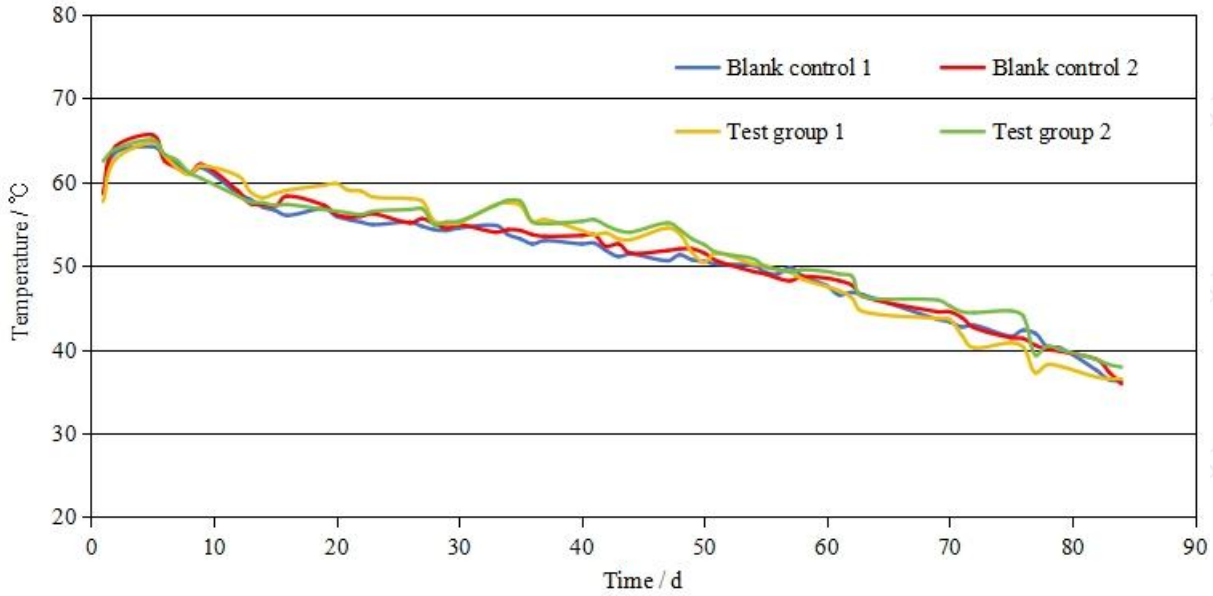


Figure 5-1 Internal temperature of compost during the test

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5.6.2 Oxygen concentration

1) Oxygen concentration

The oxygen concentrations inside the composting material were all above 10% during the test. Results are shown in Table 5-4 and Figure 5-2.

Table 5-4 Oxygen concentration inside the composting material during the test (%)

Time (d)	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
1	20.6	19.9	20.0	20.3
2	19.7	19.0	19.5	19.2
5	19.5	19.8	19.8	19.0
6	19.5	19.8	19.6	19.3
7	19.1	19.5	19.8	18.9
8	18.9	19.7	19.5	19.2
9	19.0	19.5	19.4	19.4
12	19.5	19.6	19.6	19.5
13	19.2	19.7	19.3	19.3
14	19.0	19.0	19.4	19.5
15	18.7	18.9	19.5	19.8
16	19.0	19.2	19.8	19.6
19	19.2	18.7	19.6	19.7
20	19.5	19.2	19.2	19.0
21	19.2	19.6	19.0	19.3
22	19.7	19.3	18.8	19.4
23	19.8	19.6	19.0	19.6
26	20.2	19.6	19.2	19.8
27	20.5	19.6	19.5	19.9
28	20.2	20.2	19.9	20.3
29	20.3	20.0	20.5	20.0
30	20.4	20.3	20.2	19.8
33	20.0	20.0	20.0	20.3

(Brought down)

Continued table 5-4 Oxygen concentration inside the composting material during the test (%)

Time (d)	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
34	20.2	20.2	20.0	20.2
35	20.3	20.1	19.8	20.6
36	20.5	20.2	20.5	20.7
37	20.6	20.5	20.6	20.7
42	20.5	20.7	20.4	20.3
49	20.8	20.8	20.8	20.9
56	20.9	20.8	20.9	20.9
63	20.8	20.9	20.9	20.8
70	20.9	20.8	20.5	20.8
77	20.7	20.9	20.7	20.7
84	20.8	20.8	20.8	20.8

2) Oxygen concentration profile

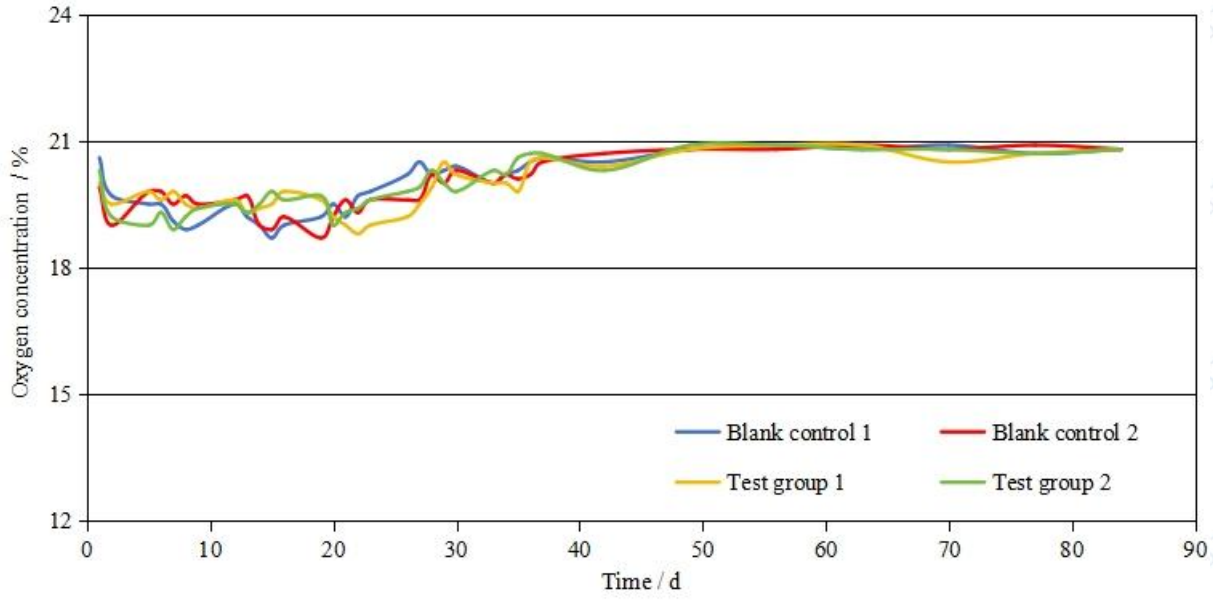


Figure 5-2 Oxygen concentration inside the composting material during the test

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5.6.3 Moisture content

1) Moisture content

The moisture content of composting material was not below 50% mass fraction at the start of the test, and not below 40% during the test. Results are shown in Table 5-5 and Figure 5-3.

Table 5-5 Moisture content of composting material during the test (%)

Time (d)	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
0	57.4	57.4	57.4	57.4
7	63.9	60.4	54.6	50.9
14	52.9	51.4	56.8	56.5
21	63.2	63.6	60.0	62.8
28	60.7	61.5	63.2	63.8
42	62.4	60.4	62.3	62.2
56	49.0	50.8	66.8	61.4
70	55.9	56.0	64.4	59.7
84	51.2	45.8	60.3	53.4

2) Moisture content profile

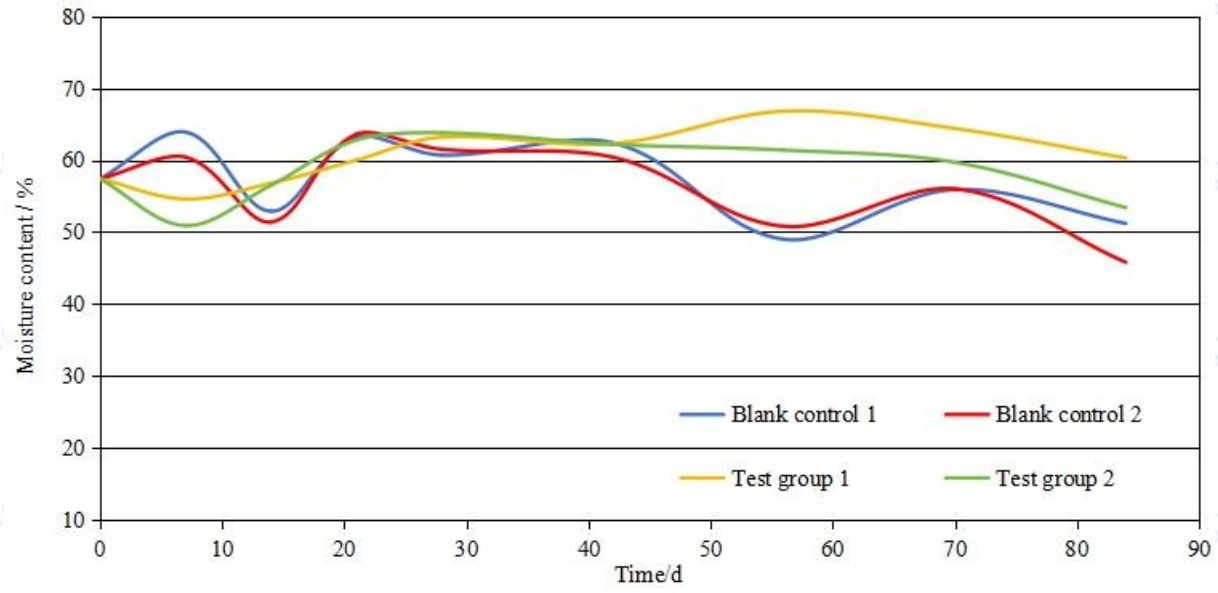


Figure 5-3 Moisture content of composting material during the test

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5.6.4 pH

1) pH value

The pH of composting material was increased to above 7 during the test and did not fall below 5, which met the validity requirement of test standard. Results are shown in Table 5-6 and Figure 5-4.

Table 5-6 pH value of composting material during the test

Time (d)	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
0	5.54	5.54	5.54	5.54
7	8.34	7.15	7.79	7.67
14	8.52	8.50	8.31	8.35
21	7.83	7.91	7.35	7.50
28	7.75	7.95	7.77	7.78
42	7.10	7.03	7.48	7.36
56	7.28	7.16	7.36	7.60
70	7.34	7.12	7.35	7.40
84	7.29	7.48	7.35	7.30

2) pH value profile

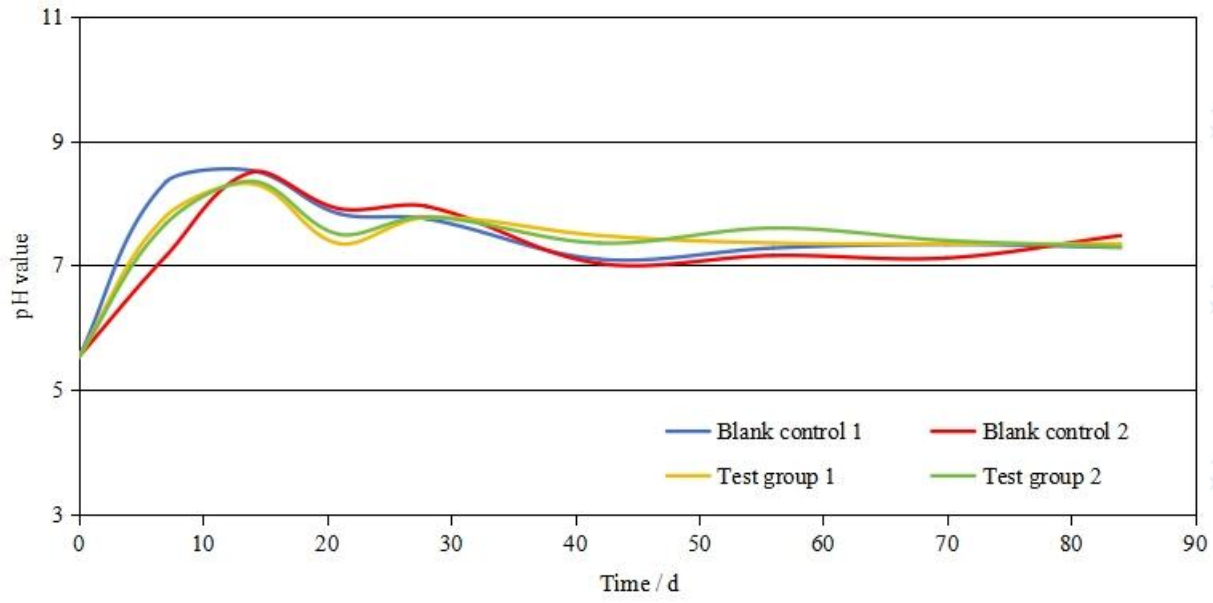


Figure 5-4 pH value of composting material during the test

(Brought down)

5.6.5 The wet mass of the total compost at the end of the test

Table 5-7 Wet mass of the total compost

Group	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Wet mass (kg)	8.846	8.460	16.707	14.007

5.6.6 Physical-chemical parameters of homogeneous sample of the < 10 mm fraction of compost at the end of test

Table 5-8 physical-chemical parameters of compost at the end of the test

Group	Blank control		Test group	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Total dry solids (%)	65.7	61.6	48.0	55.2
Volatile solids (%)	41.5	41.8	44.2	44.2
pH	7.2	7.5	7.2	7.3
TOC (%)	22.0	22.2	20.8	22.6
Total nitrogen (g/kg)	17	16	18	18
Ammonium nitrogen (mg/kg)	6.98	9.36	8.86	7.53
Nitrite nitrogen (mg/kg)	15.04	15.17	8.64	7.18
Nitrate nitrogen (mg/kg)	1.45×10^3	1.49×10^3	2.25×10^3	2.25×10^3
Maturity of compost	Rottegrad V	Rottegrad V	Rottegrad V	Rottegrad V
Bulk density (dry weight basis, kg/L)	0.288	0.298	0.283	0.240
Salt content (dS/m)	3.49	3.75	4.89	4.34
Phosphorus (g/kg)	4.3	4.3	4.6	4.7
Magnesium (g/kg)	4.6	4.6	3.8	3.9
Potassium (g/kg)	3.9	4.0	3.3	3.4

(Brought down)

5.6.7 Degree of disintegration

The test result showed that the degree of disintegration of test material at the end of test was 92.6%. Results are shown in Table 5-9.

Table 5-9 Degree of disintegration

Test material	Replicate 1	Replicate 2
The dry weight of test material at the beginning of the test (g)	169.8	171.0
The dry weight of test material after sieving at the end of the test (g)	11.5122	13.8480
The degree of disintegration (%)	93.2	91.9
Average (%)	92.6	

Note: The test material discussed in this table referred to the test material that was introduced into the test system in the form of 10 cm × 10 cm film.

5.7 Validity of the test

a) the temperature regime as described below had been respected (see 5.6.1):
   - Days 2 to 7: between 60 °C and 75 °C;
   - Days 8 to 28: between (55 ± 5) °C and (70 ± 5) °C;
   - Days 29 to 56: between (50 ± 5) °C and (65 ± 5) °C;
   - Days 57 to 70: below 55 °C;
   - Days 71 to 84: below 45 °C.

b) The pH was increased to a value above 7 during the test and did not fall below 5 (see 5.6.4).

c) The biowaste compost of the blank control had a maturity (Rottegrad) of V after 12 weeks.

The test results all met the validity requirement of the test standard, which revealed that the test results were valid.

5.8 Deviations from the test standard and SOPs

No deviation from the test standard and SOPs occurred during the test.

5.9 Conclusion

Under the conditions of this test, the degree of disintegration of the test material was 92.6%, which met the requirement specified in standards EN 13432:2000, ASTM D6400-2023 and AS 4736-2006.

(Brought down)

5.10 Visual observations

No suspicion of visual contamination can be seen at the end of the test. The final interpretation is to be assessed by the certification body as the presence of visual contamination will render this test result uncompliant with the standard/certification scheme. Photos from one of the replicates in each group are shown below:



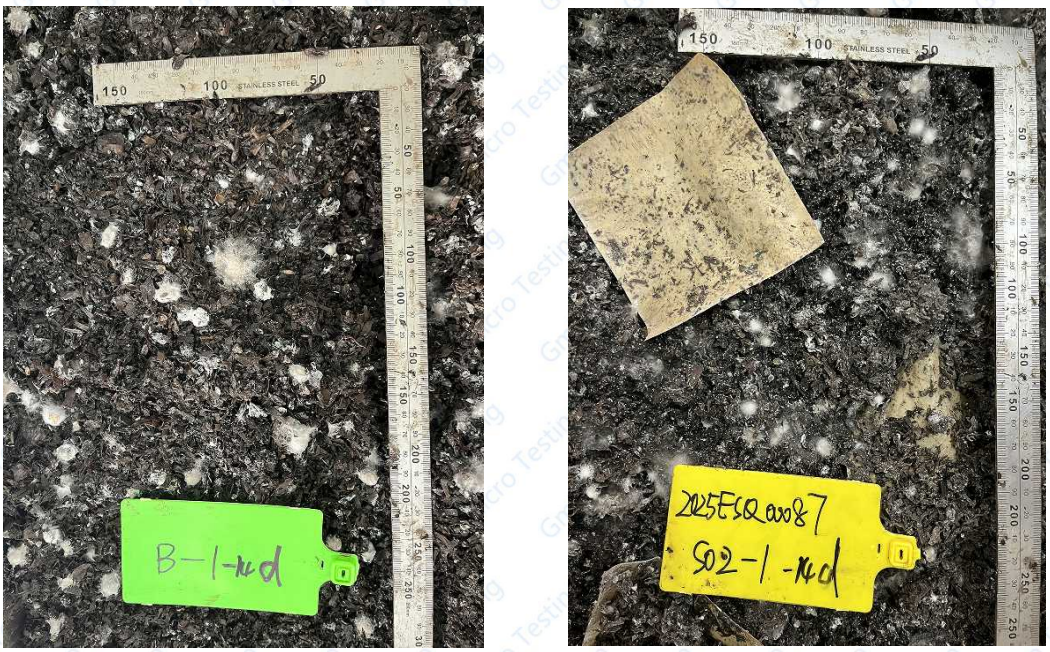
The appearance of blank group (left) and test group (right) —— at the start of the test



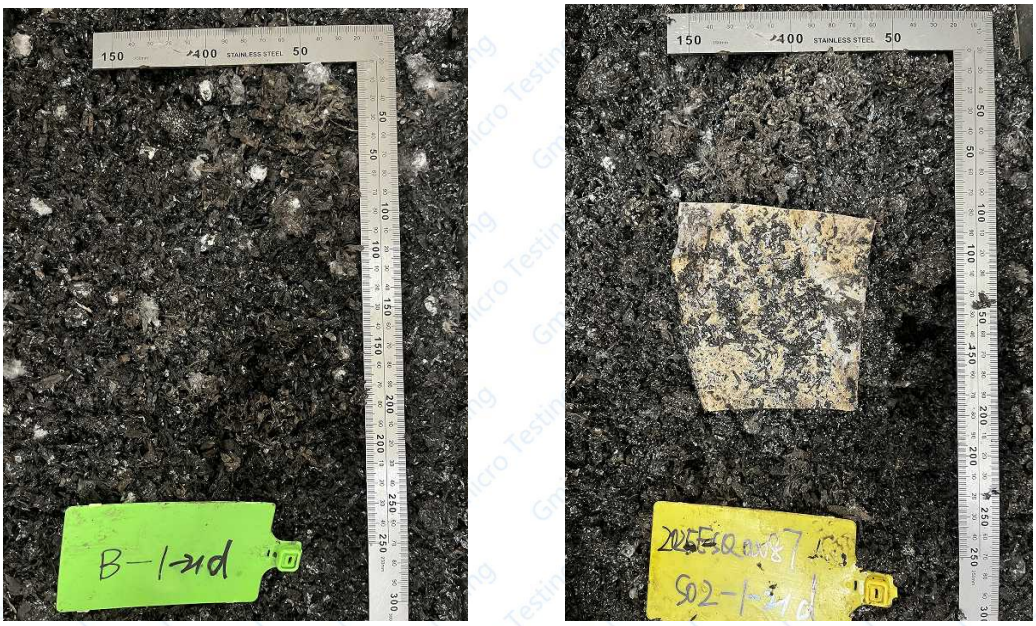
The appearance of blank group (left) and test group (right) —— the first week

(Brought down)

Report №. 2025ESQ00087R01E



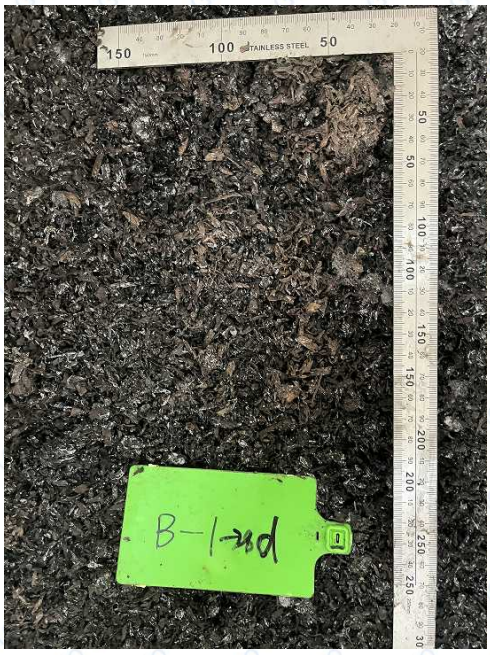
The appearance of blank group (left) and test group (right) —— the second week



The appearance of blank group (left) and test group (right) —— the third week

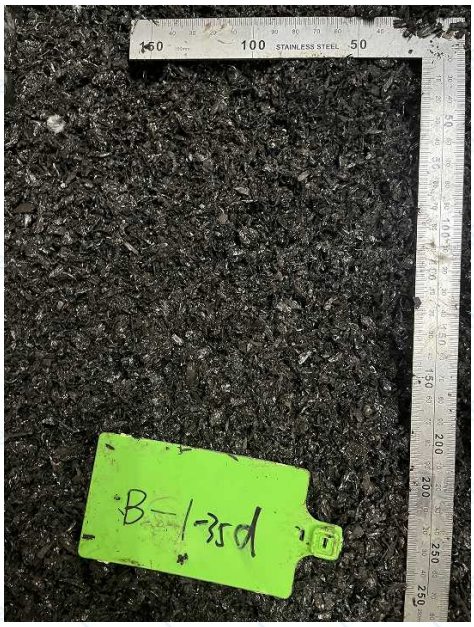
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Report №. 2025ESQ00087R01E





The appearance of blank group (left) and test group (right) —— the fourth week



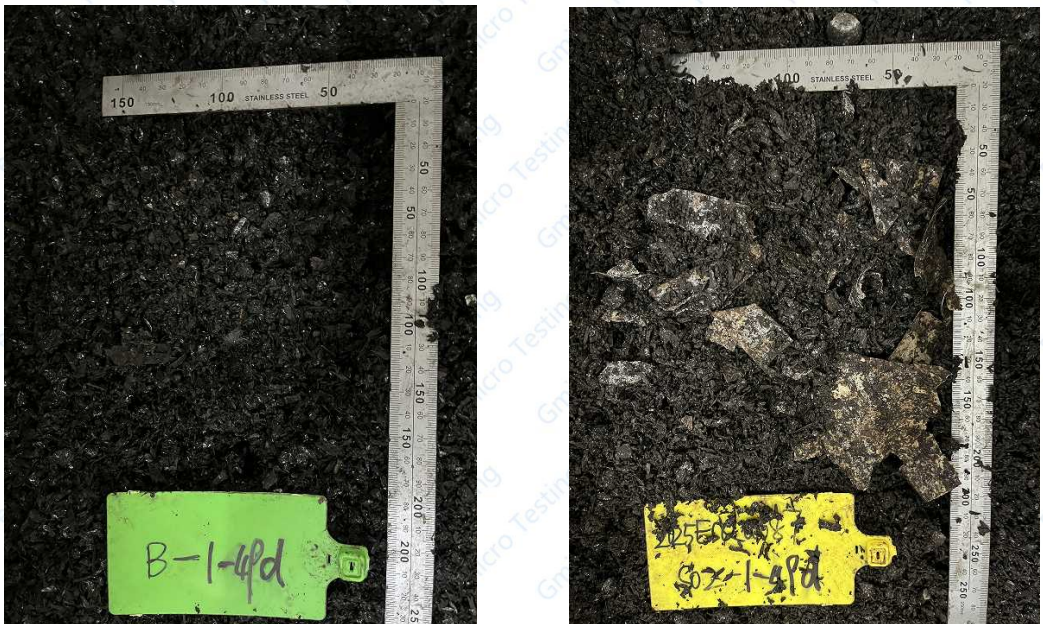


The appearance of blank group (left) and test group (right) —— the fifth week

(Brought down)



The appearance of blank group (left) and test group (right) —— the sixth week

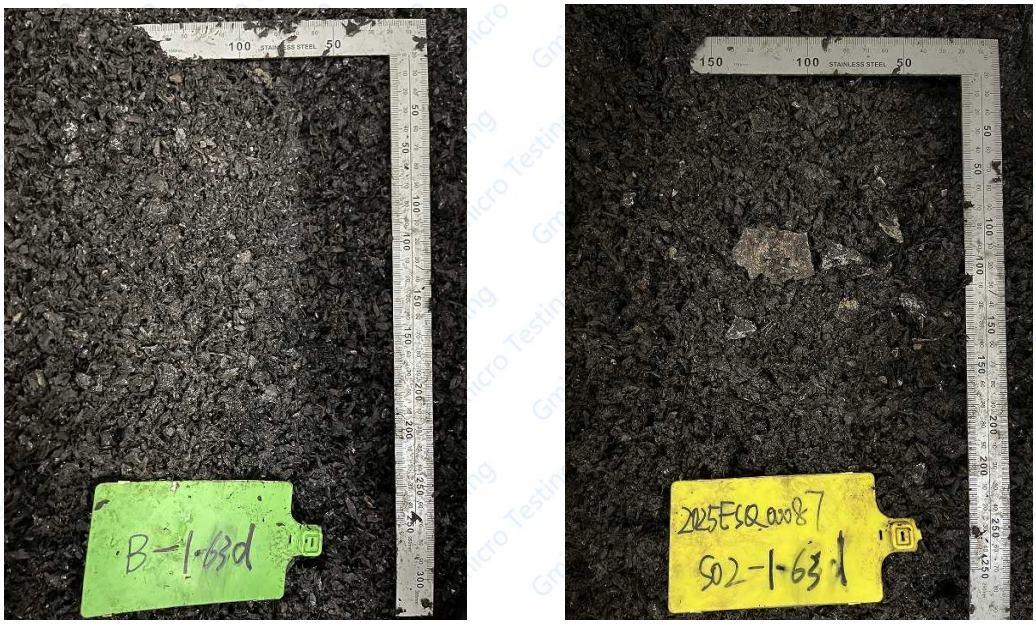


The appearance of blank group (left) and test group (right) —— the seventh week

(Brought down)



The appearance of blank group (left) and test group (right) —— the eighth week



The appearance of blank group (left) and test group (right) —— the ninth week

(Brought down)





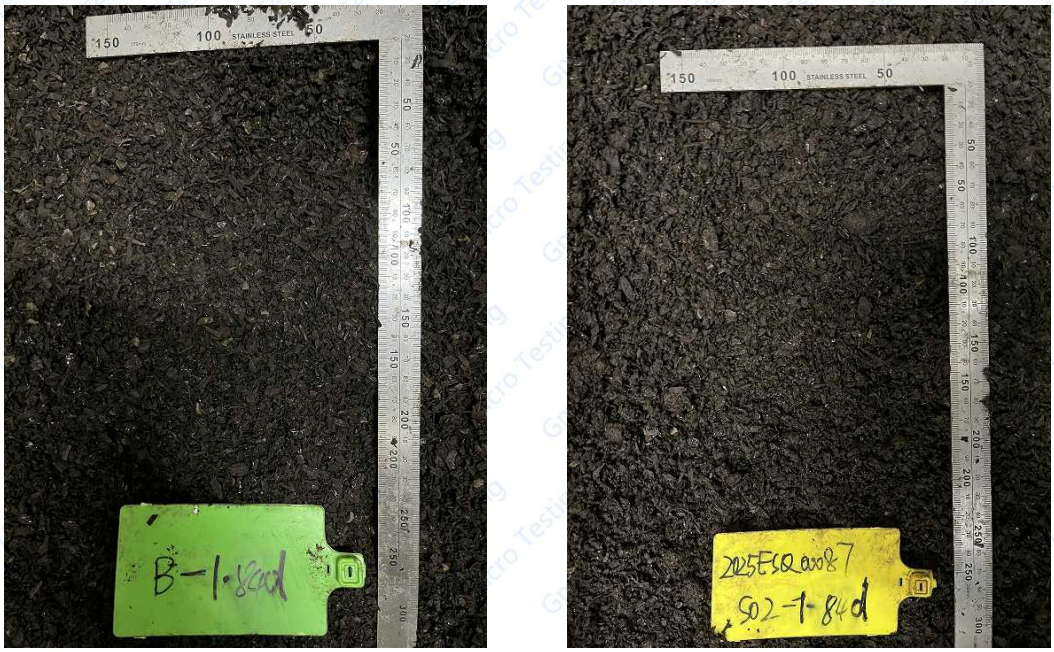
The appearance of blank group (left) and test group (right) —— the tenth week





The appearance of blank group (left) and test group (right) —— the eleventh week

(Brought down)



The appearance of blank group (left) and test group (right) —— the twelfth week

(Brought down)

6 Ecotoxicity (terrestrial plant test)

6.1 Test method

The ecotoxicity test was conducted based on OECD guideline 208: 2006 with the modifications in Annex E of EN 13432: 2000.

6.2 Test system

6.2.1 Test species

Wheat and mung bean were selected as the test species. The tested seeds were all rinsed and soaked with deionized water for one hour before the test.

6.2.2 Reference substrate

Name	Commercial potting soil
TOC content	17.5%
Soil moisture content	58.5%

6.3 Procedure

6.3.1 Test design

For each plant seed, two blank compost groups (25%, 50% compost) and two sample compost groups (25%, 50% compost) were prepared, with three replicates of each group and 100 seeds per replicate. Details are shown in Table 6-1.

Table 6-1 Preparation of ecotoxicity test system

Species	Group	Reference substrate (g)	Blank compost (g)	Sample compost (g)	Replicate	Number of seed per replicate
Wheat	25% Blank compost	542	118	—	3	100
	25% Sample compost	542	—	145	3	100
	50% Blank compost	361	236	—	3	100
	50% Sample compost	361	—	291	3	100
Mung bean	25% Blank compost	542	118	—	3	100
	25% Sample compost	542	—	145	3	100
	50% Blank compost	361	236	—	3	100
	50% Sample compost	361	—	291	3	100

Note: the total dry solid content of the blank compost, sample compost, and reference substrate was 63.7%, 51.6%, and 41.5%, respectively, and the proportion of compost and reference substrate was calculated by dry weight.

6.3.2 Analysis and determination

(1) Blank compost, sample compost and reference substrate were weighed and mixed well according to Table 6-1, the moisture contents of the mixture were adjusted to 70% - 100% of water holding capacity by adding deionized water. Then, 100 seeds were sown in each pot evenly and covered with perlite on the surface.

(2) The pots were placed in darkness for cultivation until the germination rate of the blank compost group exceeded 50%, at which point light was provided.

(3) Deionized water was supplied periodically during the test duration to maintain a suitable moisture content.

(4) Emergence number and any visible detrimental effects in the plants post-emergence for each pot were observed and recorded during the test period.

(5) Test temperature, humidity and watering were recorded during the test.

(6) Light intensity was measured and recorded when light was first provided and at the end of the test.

(7) The positions of the pots were adjusted regularly to reduce growth differences caused by random factors.

(8) The test had ended 17 days after the germination rate of the seeds in the blank control group exceeded 50%. Then, the above-ground parts of the plants were harvested and weighed to obtain the fresh shoot weight. After drying at 60℃ until they reached a constant weight, the shoots were weighed to obtain the dry shoot weight, thereby characterizing the plant biomass.

6.3.3 Test conditions

Temperature	23.8 ℃ - 26.9 ℃ (within 12 ℃ - 32 ℃)
Humidity	65.2% - 84.9% (within 45% - 95%)
Photoperiod	16 hours light / 8 hours dark
Light intensity	At the beginning when light was provided: 2.38×10^4 lx, at the end of the test: 2.40×10^4 lx (within 22000 lx - 29330 lx)

6.3.4 Calculation

(1) The germination rate of seed was calculated based on the equation below:

$$R_g = \frac{n_g}{n_t} \times 100$$

where

R_g is the germination rate of seed, expressed in percent (%);

n_t is the total number of seeds exposed in the test system at the start of test;

n_g is the number of germinated seeds at the end of test.

(2) The biomass proportion of test group to the control group was calculated based on the equation below:

$$P = \frac{w_t}{w_b} \times 100$$

where

P is the biomass proportion of test group to the control group, expressed in percent (%);

w_t is the shoot dry weight or fresh weight of test group, in gram (g);

w_b is the shoot dry weight or fresh weight of blank control, in gram (g).

(Brought down)

6.4 Test result

Under the current conditions, the germination rates of wheat and mung beans in all sample compost groups exceeded 90% of those in the corresponding blank compost groups, and no visible detrimental effects had been found in the blank compost group and sample compost group. Additionally, the biomass (including both dry and fresh shoot weights) of wheat and mung beans in all sample compost groups was above 90% of that in the corresponding blank compost group. Details are shown in Table 6-2, Table 6-3 and Table 6-4

Table 6-2 The germination rate for each test plant

Species		Wheat				Mung bean			
Group		Blank compost		Sample compost		Blank compost		Sample compost	
		25%	50%	25%	50%	25%	50%	25%	50%
Germination	Replicate 1	94	99	98	93	96	92	98	96
	Replicate 2	91	95	92	90	96	100	94	97
	Replicate 3	97	86	96	90	98	92	94	97
Total germination		282	280	286	273	290	284	286	290
Total seed		300	300	300	300	300	300	300	300
Germination rate (%)		94	93	95	91	97	95	95	97
Percentage of germination of sample compost group relative to that of the blank compost group (%)		—	—	101	98	—	—	99	102

Table 6-3 Observation of visible detrimental effects

Species	Group	Total seedling emergence	Total number of surviving plants	Total abnormal seedling	Healthy seedling Percentage (%)
Wheat	25% Blank compost	282	282	0	100
	50% Blank compost	280	280	0	100
	25% Sample compost	286	286	0	100
	50% Sample compost	273	273	0	100
Mung bean	25% Blank compost	290	290	0	100
	50% Blank compost	284	284	0	100
	25% Sample compost	286	286	0	100
	50% Sample compost	290	290	0	100

(Brought down)

Table 6-4 Plant biomass at the end of the test

Species	Group	Rep[a]	Fresh shoot weight			Dry shoot weight		
			Fresh shoot weight (g)	Average (g)	Percentage (%) [b]	Dry shoot weight (g)	Average (g)	Percentage (%) [b]
Wheat	25% Blank compost	1	48.3424	48.378	—	4.0850	4.037	—
		2	47.9352			3.9179		
		3	48.8568			4.1066		
	50% Blank compost	1	49.1428	49.080	—	3.6841	3.817	—
		2	51.2165			4.0068		
		3	46.8810			3.7606		
	25% Sample compost	1	49.6192	50.311	104	4.3651	4.136	102
		2	49.6125			3.8647		
		3	51.7013			4.1781		
	50% Sample compost	1	44.6179	44.900	91.5	3.8949	3.853	101
		2	44.1197			3.8145		
		3	45.9627			3.8493		
Mung bean	25% Blank compost	1	85.8411	89.113	—	7.7956	8.182	—
		2	91.7831			8.1679		
		3	89.7162			8.5831		
	50% Blank compost	1	89.6337	90.006	—	7.6565	7.786	—
		2	90.9653			8.0628		
		3	89.4199			7.6392		
	25% Sample compost	1	91.9524	92.665	104	8.5853	8.731	107
		2	91.2719			9.4214		
		3	94.7720			8.1867		
	50% Sample compost	1	96.6478	96.134	107	8.4937	8.658	111
		2	102.7438			8.6998		
		3	89.0110			8.7810		

Note: [a] means replicate; [b] Percentage of the plant biomass of the sample compost to that of the corresponding blank compost.

(Brought down)

6.5 Validity of the test

— The lowest seedling emergence in control was 93%, greater than 70%.

— The seedlings in control had not exhibited visible phytotoxic effects (e.g. chlorosis, necrosis, wilting, leaf and stem deformations) and the plants exhibit only normal variation in growth and morphology for that particular species.

— In the duration of the study, the survival seedlings in controls were all 100%, greater than 90%.

The above results all met the requirement of the test, which revealed that the test results were valid.

6.6 Deviations from the test standard and SOPs

No deviation from the test standard and SOPs occurred during the ecotoxicity test.

6.7 Conclusion

Under the current conditions, the germination rates of wheat and mung beans in all sample compost groups exceeded 90% of those in the corresponding blank compost groups. Additionally, the biomass (including both dry and fresh shoot weights) of wheat and mung beans in all sample compost groups was above 90% of that in the corresponding blank compost group. Indicated that the test results met the requirements of EN 13432:2000, ASTM D6400-2023 and AS 4736-2006.

(Brought down)

6.8 The appearance of the plant at the end of test



Wheat: 25% Blank compost (3 pots on the left) and 25% Sample compost (3 pots on the right)



Wheat: 50% Blank compost (3 pots on the left) and 50% Sample compost (3 pots on the right)

(Brought down)



Mung bean: 25% Blank compost (3 pots on the left) and 25% Sample compost (3 pots on the right)



Mung bean: 50% Blank compost (3 pots on the left) and 50% Sample compost (3 pots on the right)

(Brought down)

7 Ecotoxicity (earthworm acute toxicity test)

7.1 Test method

The earthworm acute toxicity test was conducted based on ASTM E1676-12 (2021), with the modifications in AS 4736-2006.

7.2 Test system

7.2.1 Test species

Species	*Eisenia foetida* with obvious clitellum
Batch No.	EEf20250106-1
Age	Older than 3 months
Amount	180
Source	Guangdong Zhongshi Longtai Low Carbon Technology Co., Ltd.
Domesticating	The earthworms used in the test were purchased on January 6, 2025. They were raised in the laboratory under continuous light with the light intensity of 400 lx - 800 lx. The temperature was maintained at 20 ℃ ± 2 ℃, and the humidity was kept between 65% and 100%.
Sensitivity of test species	The sensitivity test was carried out using chloroacetamide (C_2H_4ClNO) as the reference substance based on the artificial soil test with the same batch of *Eisenia foetida*. The 14-day LC_{50} was 27.6 mg/kg (dry weight of artificial soil), which was within the quality control range of 10 to 100 mg/kg (dry weight of soil). Therefore, the sensitivity meets the requirements.

7.2.2 Artificial soil

The artificial soil was mixed according to the proportion of 10% peat moss (1000 g), 20% Kaolin clay (2000 g), 70% silica sand (7000 g) and 0.4% calcium carbonate (40 g).

7.2.3 Compost

The compost used for the earthworm toxicity test included blank compost from the control group and sample compost from the test group of the disintegration test. The water content of blank compost and sample compost was 57.2% and 90.4%, respectively (the calculation method was the moisture content divided by the dry weight mass, and then multiplied by 100%).

7.3 Procedure

7.3.1 Preparation of test systems

According to the water content of artificial soil and compost and the usage amount, the test system was prepared as shown in Table 7-1. Each container was assigned with 600 g dry substrate.

Before the test, all earthworms were rinsed and dried with filter paper. Then, 10 healthy earthworms were randomly placed on the surface of the test soil for each container. They could climb into the test system by themselves. The containers were sealed with plastic films with holes to prevent the test system from drying out.

(Brought down)

Table 7-1 Preparation of test system

Group	Blank compost (g)	Sample compost (g)	Artificial soil (g)	Water (mL)	Number of replicate	Wet soil of each replicate (g)
Negative control	—	—	4000	1600	6	840
25 % blank compost	786	—	1500	520	3	850
50 % blank compost	1572	—	1000	240	3	850
25 % sample compost	—	952	1500	360	3	850
50 % sample compost	—	1904	1000	0	3	880

Note: each test container contained the same amount of soil, determined on a dry weight basis of 600 g.

7.3.2 Observation and measurement

(1) The observation of test earthworms: On day 7 and day 14 of the test, each test system in the test containers was placed on the trays. The earthworms were carefully removed, and their tails were stimulated to check for any dead individuals. Any deaths, abnormal behaviors, or pathological symptoms of the test earthworms were recorded.

(2) The measurement of the weight of earthworms: On the day prior to the initiation of the test (Day - 1), the earthworms were placed in Petri dishes with wet filter paper to purge their gut contents. The uniformity of the earthworms was assessed at the initiation of the test. At the initiation and the end of the test, the number and total weight of the surviving earthworms in each container were recorded, and the mortality rate, mean weight, and percentage of biomass loss of the surviving earthworms in each group were calculated.

7.3.3 Test conditions

The test was conducted at temperatures ranging from 19.1 ℃ to 20.0 ℃, with air humidity between 71% and 88%. The continuous light intensity was 661 lx at the beginning and 603 lx at the end of the test. The pH value, water content, and salinity of the test system are shown in Table 7-2.

Table 7-2 pH value, water content, and salinity of the test system

Time	Group	Water content (%)	pH value	Soil salinity (mS/cm)
At the beginning of the test	Negative control	40.2	6.09	0.439
	25 % blank compost	41.2	7.01	1.12
	50 % blank compost	39.5	7.15	1.66
	25 % sample compost	40.3	7.08	1.33
	50 % sample compost	43.0	7.42	2.34
At the end of the test	Negative control	39.3	6.42	0.389
	25 % blank compost	41.8	7.33	1.18
	50 % blank compost	39.1	7.40	1.77
	25 % sample compost	39.9	7.66	1.42
	50 % sample compost	41.6	7.81	1.88

(Brought down)

7.3.4 Calculation

(1) The mortality rate of earthworm was calculated based on the equation below:

$$M = \frac{n_i - n_e}{n_i} \times 100$$

where

M means the mortality of earthworms (%);

n_i means the number of earthworms exposed to the test system at the initiation of the test;

n_e means the number of surviving earthworms at the end of the test.

(2) The biomass loss of earthworms was calculated based on the equation below:

$$L = \frac{b_i - b_e}{b_i} \times 100$$

where

L means the biomass loss of the earthworms at the end of the test (%);

b_i means the mean weight of earthworms at the initiation of the test (g);

b_e means the mean weight of earthworms at the end of the test (g).

7.4 Test result

Under the current conditions, the mortality of earthworms in the negative control group, blank compost group, and sample compost group were all 0% at the end of the test. No pathological symptoms or abnormal behavior were observed during the test. At the same time, the difference in mean weight of surviving earthworms between the sample compost and the blank compost were all lower than 10%. Details are shown in Table 7-3 and Table 7-4.

Table 7-3 The number and mortality of test earthworms

Group	Initial number	Day 7		Day 14		Mortality difference compared to corresponding blank compost (%)
		Death number	Mortality (%)	Death number	Mortality (%)	
Negative control	60	0	0	0	0	—
25 % blank compost	30	0	0	0	0	—
50 % blank compost	30	0	0	0	0	—
25 % sample compost	30	0	0	0	0	0
50 % sample compost	30	0	0	0	0	0

(Brought down)

Table 7-4 The mean weight of test earthworms

Group	Mean weight on day 0 (g)	Mean weight on day 14 (g)	Weight increase rate (%) [a]	Weight increase rate difference compared to corresponding blank compost (%)	Mean weight difference compared to corresponding blank compost (%) [c]
Negative control	0.364	0.344	-5.5 [b]	—	—
25 % blank compost	0.360	0.343	-4.8	—	—
50 % blank compost	0.374	0.348	-7.0	—	—
25 % sample compost	0.358	0.338	-5.6	0.8	1.5
50 % sample compost	0.371	0.340	-8.3	1.4	2.2

Note: [a] Weight increase rate (%) = (Mean weight on day 14 - Mean weight on day 0) / Mean weight on day 0;

[b] i.e. the biomass loss of negative control was 5.5%, which met the validity requirement;

[c] Mean weight difference (%) = |(Mean weight of sample compost group on day 14 - Mean weight of blank compost group on day 14)| / Mean weight of blank compost group on day 14.

7.5 Validity of the test

The conditions for the acceptability of the test were adhered to:

— Continuous lighting was used during the test;

— All the test containers were identical;

— Test organisms were cultured at the same temperature as that used for testing;

— Appropriate negative control was included in the test;

— All animals in the test population were obtained from the same source and were of acceptable quality;

— Treatments were assigned randomly to individual test chamber locations, and individual test organisms were assigned randomly to test containers;

— Each test chamber contained the same amount of soil, determined on a dry weight basis;

— The temperature was within the acceptable range;

— The mortality of earthworms in negative control was 0%, and biomass loss was not exceeded 20% of the initiate.

The above results all met the requirement of the test, which revealed that the test results were valid.

7.6 Deviations from the test standard and SOPs

No deviation from the test standard and SOPs occurred during the ecotoxicity test.

7.7 Conclusion

Under the current conditions, the test results showed that the difference in the mortality and mean weight of the surviving earthworms between the test compost and the control was not greater than 10%, meeting the ecotoxicity requirement of AS 4736-2006.

(Brought down)

7.8 The appearance of the earthworms at the end of test



The appearance of the earthworms in negative control at the end of test



The appearance of the earthworms in 25% blank compost group (left) and 25% sample compost group (right) at the end of test

(Brought down)



The appearance of the earthworms in 50% blank compost group (left) and 50% sample compost group (right) at the end of test

(Blank below)

Notice Items

1. The Test report is invalid if not affixed with Authorized Stamp of Test and Paging Seal.
2. The Test report is invalid without signature of verifier and approver.
3. The Test report is invalid if being supplemented, deleted or altered.
4. Without prior written permission, the report cannot be reproduced, except in full.
5. Unless otherwise stated, the results shown in this test report refer only to the sample(s) submitted.
6. Any dispute of the report must be raised to the testing body within 15 days after the report is received, exceeding which the dispute will not be accepted.
7. For the tested sample(s) submitted by the applicant, the sample information in the test report is provided by the applicant and the laboratory is not responsible for its authenticity.