

**GUANGDONG DETECTION CENTER OF MICROBIOLOGY**

**REPORT FOR ANALYSIS**

<b>Name of Sample</b>	Food Packaging Containers
<b>Customer</b>	Xiamen City Bigui Environmental Protection Technology Co., Ltd.
<b>Sample Receipt NO.</b>	(2012)ZD0153
<b>Place for Analysis</b>	GUANGDONG DETECTION CENTER OF MICROBIOLOGY.

**Address:** 100 Central Xian Lie Road, Guangzhou, China

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**Fax:** (020)87684587



No.L1747

## REPORT FOR ANALYSIS

Name of Sample Food Packaging Containers Way and Quantity of Reception One sample received

Specification and Group ... .. State and Characteristic Massive solid

Number of Sample ...

Customer Xiamen City Bigui Environmental Protection Technology Co., Ltd. Date for Sample Supplying February 6, 2012

Item of Analysis Degree of biodegradation Date for Analysis May 23, 2012 to October 10, 2012

Sample Receipt NO. (2012)ZD0153 Date for Reporting October 17, 2012

Standard and Methods GB/T 19277-2003 (ISO 14855:1999, IDT)

## Results

Test material: <u>Food Packaging Containers</u>	Reference material: <u>TLC grade cellulose</u>												
Origin of compost: <u>South China Botanical Garden, CAS</u>	Age of compost: <u>Two month</u>												
Volume of test vessels: <u>2 L</u>													
Method of CO <sub>2</sub> determination: <u>Measure the cumulative carbon dioxide evolved as dissolved inorganic carbon (DIC) after absorption in sodium hydroxide solution.</u>													
<b>Test results</b>													
	<table><thead><tr><th></th><th>Mean biodegradation calculated from CO<sub>2</sub> evolved (%)</th><th>Test duration (days)</th><th>Observations</th></tr></thead><tbody><tr><td>Test material</td><td>91.9</td><td>110</td><td>Sticky, softening, broken</td></tr><tr><td>Reference material</td><td>95.1</td><td>110</td><td>Unidentifiable</td></tr></tbody></table>		Mean biodegradation calculated from CO <sub>2</sub> evolved (%)	Test duration (days)	Observations	Test material	91.9	110	Sticky, softening, broken	Reference material	95.1	110	Unidentifiable
	Mean biodegradation calculated from CO <sub>2</sub> evolved (%)	Test duration (days)	Observations										
Test material	91.9	110	Sticky, softening, broken										
Reference material	95.1	110	Unidentifiable										
<b>Validity criteria</b>													
Degree of biodegradation of reference material after 45 days > 70%? <input checked="" type="radio"/> Yes <input type="radio"/> No													
Difference between percentage biodegradation of reference material in the different vessels at end of test <20% <input checked="" type="radio"/> Yes <input type="radio"/> No													
Mean CO <sub>2</sub> production in the blank vessels after 10 days in the range 50mg to 150mg CO <sub>2</sub> /g volatile solids? <input checked="" type="radio"/> Yes <input type="radio"/> No													
Remarks	Subcontract the item of TOC to Guangzhou Urban Drainage Monitoring Station.												

Checker: Guoxiang  
Business: Senior engineer

Technique Controller: Yushuang  
Business: Engineer

Official Seal:





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**1. Principle**

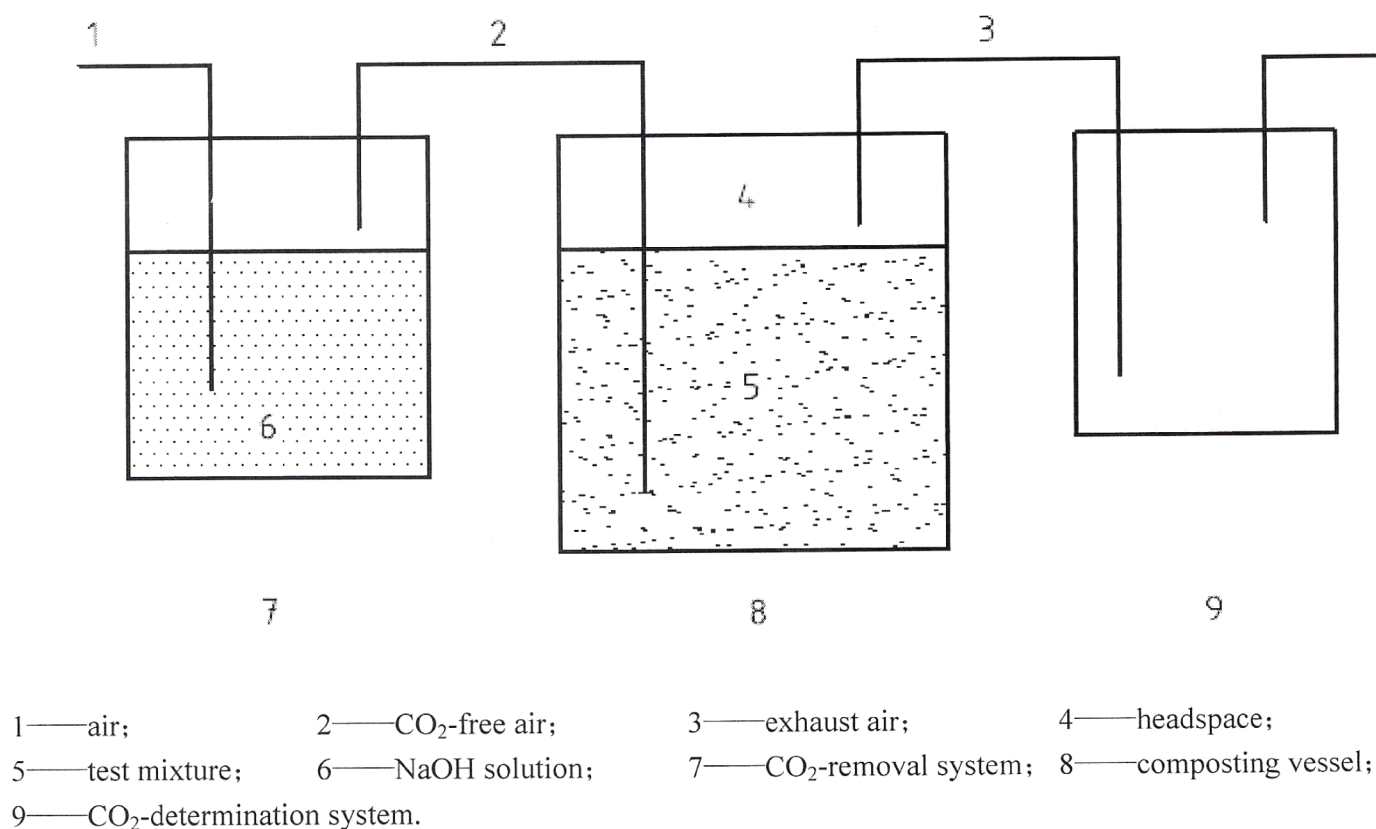
The test method determines the ultimate biodegradability and degree of disintegration of test material under conditions simulating and intensive aerobic composting process.

The test material is mixed with the inoculum and introduced into a static composting vessel where it is intensively composted under optimum oxygen, temperature and moisture conditions for a test period not exceeding 6 months.

The percentage biodegradation is given by the ratio of the carbon dioxide produced from the test material to the maximum theoretical amount of carbon dioxide that can be produced from the test material. The maximum theoretical amount of carbon dioxide produced is calculated from the measured total organic carbon (TOC) content. The percentage biodegradation does not include that amount of carbon converted to new cell biomass which is not metabolized in turn to carbon dioxide during the course of the test.

**2. Test environment**

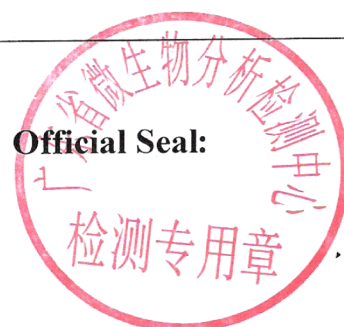
Incubation in the dark and in an enclosure at a constant temperature of  $58 \pm 2^\circ\text{C}$ .

**3. Test system****Figure 1. Layout of test system**

Checker: *Caoxiang*  
Business: Senior engineer

Technique Controller: *Yushuning*  
Business: Engineer

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### 4. Procedure

#### 4.1 Preparation of the inoculum

Well aerated compost from a properly operating aerobic composting plant was used as the inoculum. The age of the compost was 2 months.

#### 4.2 Preparation of test material and reference material

Determine the total organic carbon (TOC) of the test material and the reference material.

#### 4.3 Start-up of the test

The ratio of the dry mass of the inoculum to the dry mass of the test material was 6:1. Weigh out an amount of inoculum containing 386.4g of total dry solids and an amount of test material containing 66.7g of dry solids and mix well. Introduce the mixture into the composting vessels. Place the composting vessels in the test environment at  $58 \pm 2 \text{ }^{\circ}\text{C}$  and initiate aeration using water-saturated, carbon-dioxide-free air. A minimum of 50 g of total dry solids containing about 20 g of TOC per vessel.

#### 4.4 Incubation period

Shake the composting vessels weekly to prevent extensive channelling and to ensure uniform attack of the microorganisms on the test material.

#### 4.5 Termination of the test

### 5. Calculation and expression of results

#### 5.1 Calculation of the theoretical amount of carbon dioxide

Calculate the theoretical amount of carbon dioxide  $ThCO_2$ , in grams per vessel, which can be produced by the test material using Equation (1):

$$ThCO_2 = M_{TOT} \times C_{TOT} \times 44/12 \dots \dots \dots (1)$$

where

$M_{TOT}$  is the total dry solids, in grams, in the test material introduced into the composting vessels at the start of the test;

$C_{TOT}$  is the proportion of total organic carbon in the total dry solids in the test material, in grams per gram;

44 and 12 are the molecular mass of carbon dioxide and the atomic mass of carbon, respectively.

#### 5.2 Calculation of the percentage biodegradation

From the cumulative amounts of carbon dioxide released, calculate the percentage biodegradation  $D_i$  of the test material for each measurement interval using Equation (2):

$$D_i = \{ (CO_2)_T - (CO_2)_B \} / ThCO_2 \times 100 \dots \dots \dots (2)$$

where

$(CO_2)_T$  is the cumulative amount of carbon dioxide evolved in each composting vessel containing test material, in grams per vessel;

$(CO_2)_B$  is the mean cumulative amount of carbon dioxide evolved in the blank vessels, in grams per vessel;

$ThCO_2$  is the theoretical amount of carbon dioxide which can be produced by the test material, in grams per vessel.

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## 5.3 Expression of results

Plot the cumulative amount of carbon dioxide evolved for each composting vessel containing blank, test material and reference material as a function of time. Plot a biodegradation curve (percentage biodegradation as a function of time) for the test material and the reference material. Read from the plateau phase of the biodegradation curve the mean degree of biodegradation and report it as the final test result.

## 6. Inoculum compost

pH of suspension	The amounts of inoculum (g)	Total dry solids(g)	Moisture content (%)	Volatile solids(g)	C/N
7.5	600	386.4	35.6	194.1	19.7

## 7. Test material

Sample	Visual appearance	Total dry solids content (%)	Moisture content (%)	Total organic-carbon content (%)	ThCO <sub>2</sub> (g CO <sub>2</sub> /70g test material)
Reference material	Powder	95.57	4.43	43.57	118.83
Test material	Massive solid	96.32	4.68	56.65	145.40

## 8. Mixture of test material and inoculum compost

Test vessels	Inoculum compost		Test sample		g TOC/50g Total dry solids	C/N
	Addition (g)	Total dry solids content (g)	Addition (g)	Total dry solids content (g)		
Blank	600	386.4	/	/	/	19.7
Reference material	600	386.4	70	66.9	22.79	/
Test material	600	386.4	70	66.7	29.76	/

9. Measured cumulative CO<sub>2</sub> production and the degree of biodegradation

Day	Measured cumulative CO <sub>2</sub> production (g/vessel)					Degree of biodegradation (%)	
	Blank	Reference material	Test material	Reference material (factual)	Test material (factual)	Reference material	Test material
1	1.58	2.54	1.63	0.96	0.06	0.86	0.04
2	3.13	5.16	3.30	2.03	0.17	1.81	0.12
3	4.61	7.88	5.00	3.27	0.39	2.92	0.27
4	6.06	10.99	7.32	4.92	1.26	4.40	0.86

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Day	Measured cumulative CO <sub>2</sub> production (g/vessel)					Degree of biodegradation (%)	
	Blank	Reference material	Test material	Reference material (factual)	Test material (factual)	Reference material	Test material
5	7.44	14.86	10.84	7.42	3.40	6.63	2.34
6	8.73	18.34	14.43	9.61	5.70	8.59	3.92
7	9.99	22.76	18.14	12.77	8.15	11.42	5.60
8	11.18	27.12	21.76	15.94	10.58	14.25	7.28
9	12.34	31.53	26.46	19.20	14.12	17.17	9.71
10	13.48	35.78	31.27	22.30	17.79	19.94	12.23
11	14.61	40.21	36.17	25.59	21.56	22.89	14.83
12	15.77	44.72	40.88	28.95	25.11	25.89	17.27
13	16.90	49.37	45.73	32.47	28.83	29.03	19.83
14	18.01	53.99	50.57	35.99	32.57	32.18	22.40
15	19.10	58.71	55.48	39.61	36.38	35.42	25.02
16	20.16	63.35	60.24	43.18	40.08	38.62	27.56
17	21.11	66.81	65.04	45.70	43.93	40.86	30.21
18	22.06	70.21	69.77	48.15	47.71	43.06	32.81
19	22.86	72.50	74.44	49.64	51.58	44.39	35.48
20	23.60	74.79	78.22	51.19	54.62	45.77	37.57
21	24.34	77.11	81.92	52.77	57.58	47.18	39.60
22	25.02	79.31	85.72	54.29	60.71	48.55	41.75
23	25.63	81.58	88.21	55.96	62.58	50.04	43.04
24	26.17	83.95	90.64	57.79	64.47	51.67	44.34
25	26.71	86.36	93.07	59.65	66.35	53.34	45.63
26	27.28	88.75	95.48	61.46	68.19	54.96	46.90
27	27.80	91.04	97.87	63.24	70.07	56.55	48.19
28	28.33	93.25	100.12	64.92	71.79	58.05	49.38
29	28.84	95.38	101.75	66.54	72.91	59.50	50.15
30	29.33	97.50	103.35	68.17	74.02	60.96	50.91
31	29.80	99.14	104.93	69.34	75.13	62.01	51.67
32	30.27	100.76	106.48	70.49	76.21	63.04	52.41
33	30.70	102.30	107.92	71.60	77.22	64.03	53.11
34	31.14	103.86	109.37	72.71	78.23	65.02	53.80
35	31.58	105.40	110.94	73.82	79.37	66.01	54.58
36	32.01	107.00	112.64	74.99	80.63	67.05	55.46

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Day	Measured cumulative CO <sub>2</sub> production (g/vessel)					Degree of biodegradation (%)	
	Blank	Reference material	Test material	Reference material (factual)	Test material (factual)	Reference material	Test material
37	32.32	108.51	114.37	76.19	82.05	68.13	56.43
38	32.49	110.18	116.80	77.69	84.31	69.47	57.98
39	32.67	111.84	119.29	79.17	86.63	70.80	59.58
40	32.82	113.41	121.90	80.59	89.08	72.06	61.27
41	32.98	114.97	124.35	81.99	91.37	73.31	62.84
42	33.11	116.43	126.02	83.32	92.92	74.51	63.90
43	33.22	117.90	127.66	84.68	94.45	75.72	64.96
44	33.33	119.33	129.25	86.00	95.92	76.90	65.97
45	33.42	120.88	130.67	87.46	97.25	78.21	66.89
46	33.51	122.36	132.11	88.86	98.60	79.46	67.81
47	33.59	123.87	133.52	90.28	99.94	80.73	68.73
48	33.66	125.41	134.94	91.75	101.27	82.04	69.65
50	33.85	127.00	136.80	93.15	102.95	83.30	70.81
52	33.89	129.44	138.61	95.55	104.72	85.44	72.02
54	33.93	130.92	140.36	96.99	106.43	86.73	73.20
56	33.95	132.33	142.10	98.38	108.14	87.97	74.38
58	34.02	133.73	143.84	99.71	109.82	89.16	75.53
61	34.19	134.86	146.21	100.67	112.02	90.02	77.04
63	34.32	135.93	148.33	101.60	114.01	90.86	78.41
66	34.44	136.81	149.84	102.36	115.40	91.54	79.36
70	34.51	137.72	151.38	103.21	116.87	92.29	80.38
73	34.56	138.34	152.95	103.78	118.38	92.80	81.42
76	34.61	138.86	155.58	104.25	120.98	93.22	83.20
79	34.63	139.32	157.15	104.69	122.52	93.62	84.27
82	34.65	139.62	158.47	104.97	123.83	93.87	85.16
85	34.65	139.80	159.91	105.14	125.26	94.02	86.15
89	34.67	139.88	161.30	105.21	126.63	94.08	87.09
93	34.69	139.92	162.67	105.24	127.98	94.10	88.02
97	34.69	139.98	163.89	105.29	129.20	94.15	88.86
100	34.70	140.04	165.07	105.34	130.37	94.20	89.67
105	34.71	140.08	166.26	105.37	131.55	94.22	90.47
110	34.84	141.13	168.40	106.29	133.55	95.05	91.85

Checker: *Guoxiang*  
Business: Senior engineer

Technique Controller: *Yushuning*  
Business: Engineer

Official Seal:

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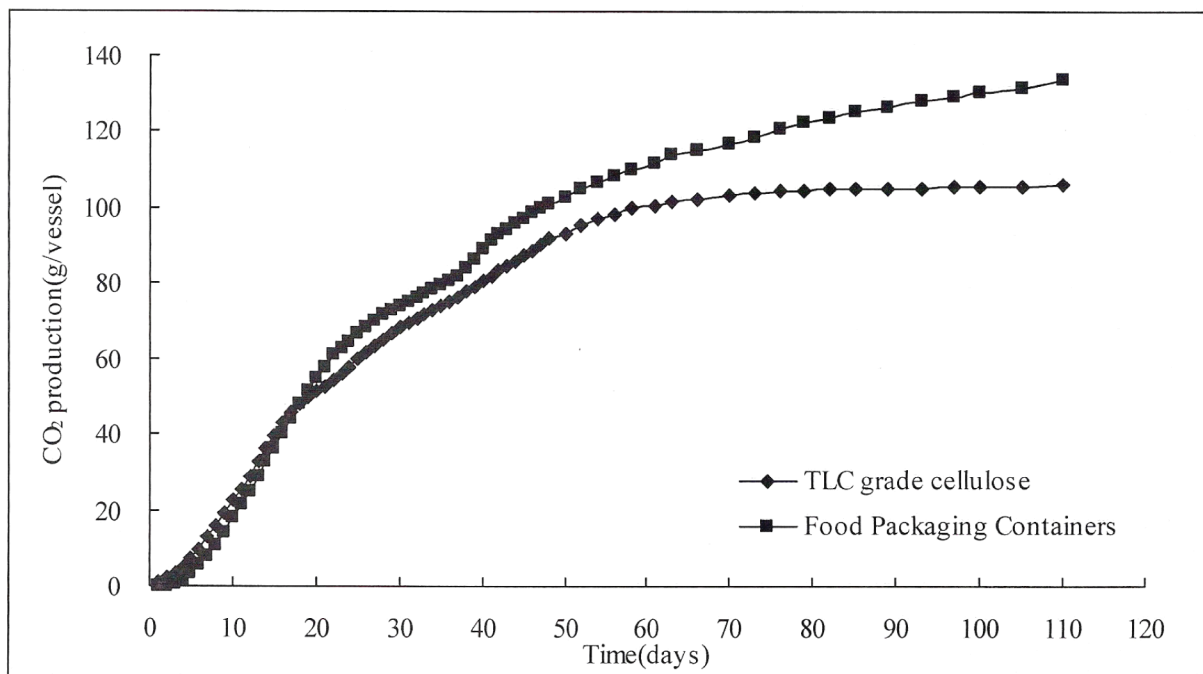


Figure 2. CO<sub>2</sub>-evolution curve

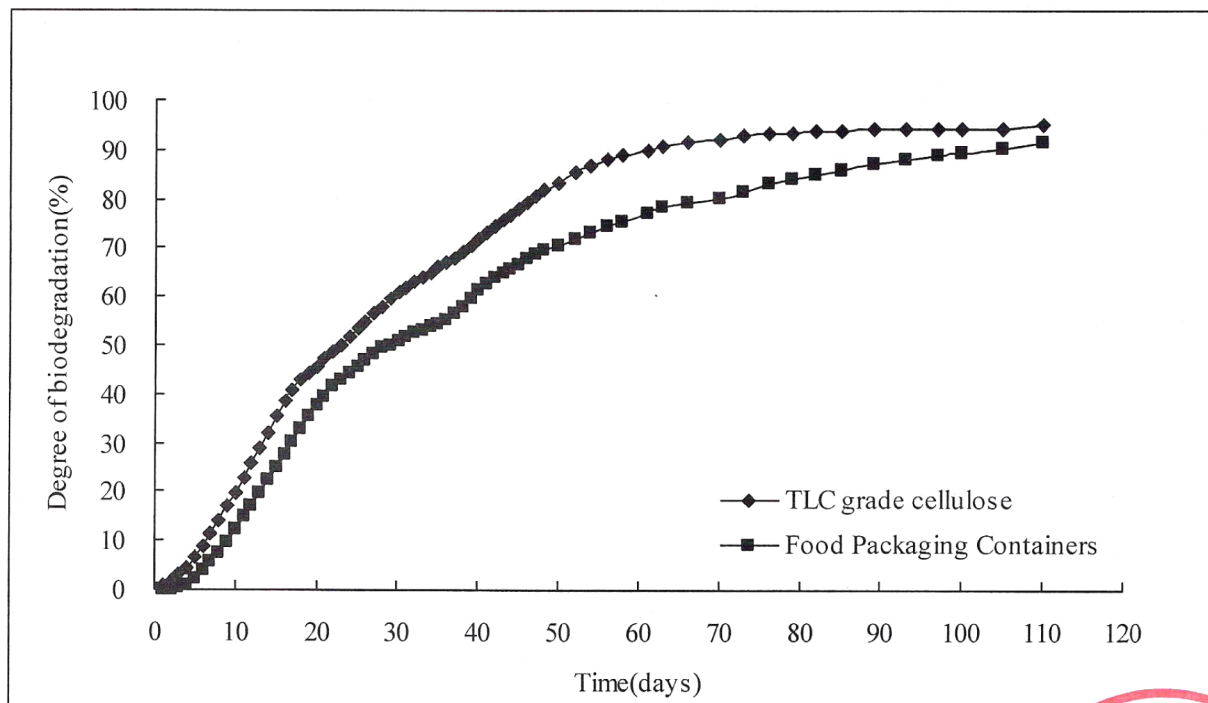


Figure 3. Biodegradation curve

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Official Seal:

