

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date: 2022. 01. 27

Page 1 of 19

PNC LABS INC

47, Gajangsaneopseo-ro,
Osan-si, Gyeonggi-do,
Korea

The following sample(s) was/were submitted and identified by/on behalf of the client as:-

SGS File No. : AYHA21-14746
Sample Description : Lyocell
Style no./Item no. : -
Order No. : -
Buyer : -
Manufacturer : PNC Labs
Country of Origin : KOREA
Country of Destination : -
Received Date : 2021. 11. 19
Test Period : 2021. 11. 19 to 2022. 01. 13
Test Method : For further details, please refer to following page (s)
Test Results : For further details, please refer to following page (s)
Report Comments : The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to Korea Laboratory Accreditation Scheme.
Result Summary :

Test Requested	Conclusion
ISO 14855-1:2012 Determination of the ultimate aerobic biodegradability of plastic material under controlled composting conditions – Method by analysis of evolved carbon dioxide – Part 1 : General method	See Result

SGS Korea Co., Ltd.



Daesung Lee / Technical Manager

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 2 of 19

The test results are as follows :

Study Title

Determination of the Ultimate Aerobic Biodegradability of Lyocell (AYHA21-14746) under Controlled Composting Conditions.

1. Summary

	Reference material	Sample
45 days degree of biodegradation (%)	77.7	51.6

Note:

- 1) During the first 10 days of testing, the compost inoculum produced 120.2 mg CO₂ per gram of volatile solids, within the range of 50 to 150 mg CO₂ per gram of volatile solids, the first 10 days of testing is therefore considered to be valid.
- 2) The percentage biodegradation of reference item Cellulose- microcrystalline, powder, 20 µm was 77.7 % after 45 days of testing, greater than 70%, the testing is therefore considered to be valid.

2. Introduction

2.1 Objective

To determine the ultimate aerobic biodegradability of test item Lyocell (AYHA21-14746) under controlled composting conditions.

2.2 Principle

The test method determines the ultimate biodegradability and degree of disintegration of test item under conditions simulating an intensive aerobic composting process. The inoculum used consists of stabilized, mature compost derived, if possible, from composting the organic fraction of solid municipal waste.

The test item 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.

During the aerobic biodegradation of the test item, carbon dioxide, water, mineral salts and new microbial cellular constituents (biomass) are the ultimate biodegradation products. The carbon dioxide produced is continuously monitored, or measured at regular intervals, in test and blank vessels to determine the cumulative carbon dioxide production. The percentage biodegradation is given by the ratio of the carbon dioxide produced from the test items to the maximum theoretical amount of carbon dioxide produced is calculated from the measured total organic carbon (TOC) content. The

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 3 of 19

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.

2.3 Test Date

Test start date: 2021. 11. 30

Test completion date: 2022. 01.13

3. Reagents and Apparatus

3.1 Test item

Identity : Lyocell

Physical Character : Solid

Storage : Room temperature

Sample Number : AYHA21-14746

3.2 Reference item

Identity : Cellulose- microcrystalline, powder, 20 µm

Lot Number : MKCL9441

Source : SIGMA-ALDRICH

Molecular formula : $(C_6H_{10}O_5)_n$ Molecular Weight : $(162.14)_n$

CAS No. : 9004-34-6

Physical Characters : White microcrystalline powder

Purity : N/A

Storage conditions : Room temp., Keep dry

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 4 of 19

3.3 Inoculum

Name : Aerobic compost

Source : Verified from supplier

3.4 Test Conditions

The test was conducted at (58 ± 2) °C, weak light conditions. There were no conditions that would interfere the growth of microbes.

3.5 Apparatus

COAD.326 Biodegradation equipment

4. Preparation Prior to Test

4.1 Preparation of test containers

Test containers were selected, thoroughly cleaned and well prepared.

4.2 Preparation of the inoculum

After coarse particles were removed and the compost was sieved, the parameters such as pH, moisture content, total dry solids, volatile solids, total nitrogen and total organic carbon were measured for compost quality control. The results were listed below:

- (1) pH : 8.9
- (2) Moisture content : 41.6 %
- (3) Total dry solids : 58.4 %
- (4) Volatile solids : 67.14 % (of dry solid)
- (5) Total nitrogen : 2.3 %
- (6) Total organic carbon : 23.41 %

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

4.3 Absorption bottles

There were 3 absorption bottles connected in series with a reaction vessel.

4.4 Number of reaction vessels

- a) Three vessels for the test items (mat-1, mat-2, mat-3)
- b) Three vessels for the positive reference item (pos-1, pos-2, pos-3)
- c) Three vessels for the blank

4.5 Preparation of test item

The parameter such as total organic carbon and moisture content were measured for test item.

The results were listed as below :

- (1) Total organic carbon : 41.54 %,
- (2) Moisture content : 9.9 %

The ratio of the dry mass of the inoculum to the dry mass of the test material shall be about 6:1. Total 120 g inoculum (dry mass) and 20 g test item (dry mass) were added in the reaction vessel for testing.

4.6 Preparation of reference item

The parameter such as total organic carbon and moisture content were measured for reference item.

The results were listed as below :

- (1) Total organic carbon : 41.95 %,
- (2) Moisture content : 4.5 %

5. Test Method

- (1) The test was conducted at $(58 \pm 2) ^\circ\text{C}$, weak light conditions. There were no conditions that would interfere the growth of microbes.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

- (2) The oxygen concentration in reaction vessel was measured twice daily in the first week of testing. Afterwards, the measurement frequency can be reduced. Adjust air flow as needed. Measure the amount of carbon dioxide absorption once a day during the first 45 days.
- (3) The air tightness of the test device was checked every day.
- (4) The composting vessels were shaken and mixed well once weekly. Mixture pH was determined and the parameters such as smell of the exhaust air, humidity of the compost, color, fungal development, structure change and disintegration of the test item were determined. Pictures of test item before test, and after 45-day of testing were shown in, respectively.
- (5) Calculation of the theoretical amount of carbon dioxide.

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

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

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.

- (6) Calculation of the percentage biodegradation.

Form the cumulative amounts of carbon dioxide released, calculate the percentage biodegradation Dt of the test material for each measurement interval using Equation 2) :

$$2) Dt = ((CO_2)_T - (CO_2)_B) / ThCO_2 \times 100$$

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.

If the differences between the individual results are less than 20%, calculate the average percentage biodegradation. If this is not the case, use the values for each composting vessel separately.

Use the same equation to calculate the degree of biodegradation of the reference material.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

6. Criteria of Results Justification

- 6.1 The degree of biodegradation of the reference item is more than 70 % after 45 days of testing.
- 6.2 Prepare the curves of cumulative amount of carbon dioxide production against time and the curves of percentage biodegradation against time for the test item and reference item respectively.
- 6.3 The inoculum in the blank has produced more than 50 mg but less than 150 mg of carbon dioxide per gram of volatile solids (mean values) after 10 days of testing.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 8 of 19

7. Results

7.1 Calculation of the theoretical amount of carbon dioxide (ThCO₂)

Reaction Vessels	Inoculum			Reference item			Sample		
No.	1	2	3	4	5	6	7	8	9
Wet solids of inoculum (g)	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
Total dry solids of inoculum (g)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
Wet solids of reference item or test item (g)	/	/	/	20.94	20.94	20.94	22.20	22.20	22.20
M _{TOT} (g)	/	/	/	20.0	20.0	20.0	20.0	20.0	20.0
TOC (%)	23.41			41.95			41.54		
C _{TOT} (g/g)	0.2341			0.4195			0.4154		
ThCO ₂ (g/vessel)	/	/	/	30.8	30.8	30.8	30.5	30.5	30.5

Note: $\text{ThCO}_2 = M_{\text{TOT}} \times C_{\text{TOT}} \times 44/12$ 7.2 Cumulative CO₂ production and percentage biodegradation during the test period

Date	Time(Day)	Cumulative CO ₂ production (g/vessel)					Percentage biodegradation (%)			
		Blank	Reference material		Sample		Reference material		Sample	
		Average	CO ₂	Average	CO ₂	Average	D%	Average	D%	Average
2021.11.30	1	1.52	2.56	1.99	1.51	1.53	3.4	1.5	0.0	0.1
			1.90		1.54		1.2		0.1	
			1.52		1.55		0.0		0.1	
2021.12.01	2	3.39	7.59	6.13	3.39	3.42	13.7	8.9	0.0	0.1
			6.92		3.45		11.5		0.2	
			3.89		3.41		1.6		0.1	
2021.12.02	3	5.30	13.70	12.93	5.34	5.32	27.3	24.8	0.1	0.1
			14.10		5.31		28.6		0.0	
			10.98		5.32		18.5		0.1	

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 9 of 19

Date	Time(Day)	Cumulative CO ₂ production (g/vessel)					Percentage biodegradation (%)			
		Blank	Reference material		Sample		Reference material		Sample	
		Average	CO ₂	Average	CO ₂	Average	D%	Average	D%	Average
2021.12.03	4	6.29	16.46	16.28	6.30	6.31	33.1	32.5	0.0	0.1
			18.13		6.31		38.5		0.1	
			14.24		6.31		25.9		0.1	
2021.12.04	5	6.53	16.98	16.95	6.54	6.55	34.0	33.8	0.0	0.1
			19.12		6.56		40.9		0.1	
			14.74		6.55		26.7		0.1	
2021.12.05	6	7.28	19.30	19.33	7.49	7.35	39.1	39.2	0.7	0.2
			21.40		7.28		45.9		0.0	
			17.29		7.29		32.5		0.0	
2021.12.06	7	8.17	23.04	23.43	9.56	8.89	48.3	49.6	4.6	2.3
			25.19		8.66		55.3		1.6	
			22.06		8.44		45.1		0.9	
2021.12.07	8	8.71	24.96	25.87	11.03	10.15	52.8	55.8	7.6	4.7
			27.22		9.93		60.2		4.0	
			25.42		9.50		54.3		2.6	
2021.12.08	9	9.23	26.36	27.65	12.57	11.56	55.7	59.9	11.0	7.6
			28.59		11.21		62.9		6.5	
			27.99		10.89		61.0		5.5	
2021.12.09	10	9.68	27.29	28.87	13.61	12.67	57.2	62.4	12.9	9.8
			29.55		12.29		64.6		8.6	
			29.77		12.10		65.3		7.9	
2021.12.10	11	10.07	27.89	29.64	14.38	13.52	57.9	63.6	14.2	11.3
			30.25		13.20		65.6		10.3	
			30.78		12.97		67.3		9.5	
2021.12.11	12	10.30	28.20	30.05	14.98	14.17	58.2	64.2	15.4	12.7
			30.64		13.93		66.1		11.9	
			31.30		13.59		68.3		10.8	

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 10 of 19

Date	Time(Day)	Cumulative CO ₂ production (g/vessel)					Percentage biodegradation (%)			
		Blank	Reference material		Sample		Reference material		Sample	
		Average	CO ₂	Average	CO ₂	Average	D%	Average	D%	Average
2021.12.12	13	10.69	28.97	30.93	15.70	14.99	59.4	65.8	16.5	14.1
			31.47		14.93		67.6		13.9	
			32.35		14.34		70.4		12.0	
2021.12.13	14	11.20	29.98	32.03	16.40	15.71	61.1	67.7	17.1	14.8
			32.49		15.69		69.2		14.8	
			33.61		15.03		72.9		12.6	
2021.12.14	15	11.74	30.85	32.88	17.12	16.42	62.1	68.7	17.7	15.4
			33.25		16.42		69.9		15.4	
			34.55		15.73		74.1		13.1	
2021.12.15	16	12.23	31.69	33.65	17.80	17.09	63.3	69.6	18.3	16.0
			33.91		17.08		70.5		15.9	
			35.34		16.39		75.1		13.7	
2021.12.16	17	12.62	32.35	34.28	18.44	17.71	64.1	70.4	19.1	16.7
			34.51		17.66		71.1		16.5	
			35.99		17.02		76.0		14.4	
2021.12.17	18	12.96	32.93	34.87	19.20	18.34	64.9	71.2	20.5	17.7
			35.07		18.21		71.9		17.2	
			36.62		17.62		76.9		15.3	
2021.12.18	19	13.22	33.40	35.36	20.07	18.98	65.6	72.0	22.5	18.9
			35.55		18.69		72.6		17.9	
			37.14		18.18		77.7		16.3	
2021.12.19	20	13.54	33.86	35.80	20.98	19.65	66.1	72.4	24.4	20.1
			35.98		19.18		73.0		18.5	
			37.55		18.80		78.1		17.3	
2021.12.20	21	13.83	34.38	36.27	21.88	20.30	66.8	72.9	26.4	21.2
			36.44		19.68		73.5		19.2	
			38.00		19.33		78.6		18.0	

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 11 of 19

Date	Time(Day)	Cumulative CO ₂ production (g/vessel)					Percentage biodegradation (%)			
		Blank	Reference material		Sample		Reference material		Sample	
		Average	CO ₂	Average	CO ₂	Average	D%	Average	D%	Average
2021.12.21	22	14.13	34.87	36.69	22.81	20.96	67.4	73.3	28.5	22.4
			36.85		20.18		73.9		19.9	
			38.36		19.90		78.8		18.9	
2021.12.22	23	14.38	35.23	37.01	23.55	21.56	67.8	73.6	30.1	23.6
			37.15		20.70		74.0		20.7	
			38.64		20.44		78.9		19.9	
2021.12.23	24	14.59	35.57	37.29	24.15	22.15	68.2	73.8	31.4	24.8
			37.41		21.28		74.2		22.0	
			38.89		21.01		79.0		21.1	
2021.12.24	25	14.74	35.84	37.53	24.71	22.65	68.6	74.1	32.7	26.0
			37.66		21.75		74.5		23.0	
			39.08		21.49		79.1		22.2	
2021.12.25	26	14.93	36.19	37.87	25.36	23.24	69.1	74.5	34.2	27.3
			38.07		22.31		75.2		24.2	
			39.34		22.06		79.3		23.4	
2021.12.26	27	15.18	36.67	38.29	25.87	23.76	69.9	75.1	35.1	28.2
			38.58		22.80		76.1		25.0	
			39.63		22.60		79.5		24.4	
2021.12.27	28	15.38	37.08	38.63	26.32	24.22	70.5	75.6	35.9	29.0
			38.93		23.15		76.6		25.5	
			39.87		23.19		79.6		25.6	
2021.12.28	29	15.57	37.52	38.97	26.75	24.76	71.4	76.1	36.7	30.2
			39.30		23.60		77.1		26.4	
			40.10		23.94		79.7		27.5	
2021.12.29	30	15.75	37.91	39.27	27.22	25.32	72.0	76.4	37.6	31.4
			39.59		24.08		77.5		27.3	
			40.31		24.67		79.8		29.3	

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 12 of 19

Date	Time(Day)	Cumulative CO ₂ production (g/vessel)					Percentage biodegradation (%)			
		Blank	Reference material		Sample		Reference material		Sample	
		Average	CO ₂	Average	CO ₂	Average	D%	Average	D%	Average
2021.12.30	31	15.91	38.22	39.50	27.67	25.82	72.5	76.7	38.6	32.5
			39.80		24.50		77.6		28.2	
			40.49		25.29		79.9		30.8	
2021.12.31	32	16.08	38.52	39.73	28.30	26.44	72.9	76.9	40.1	34.0
			40.02		25.06		77.8		29.5	
			40.66		25.96		79.9		32.4	
2022.01.01	33	16.25	38.79	39.95	29.04	27.15	73.3	77.0	42.0	35.8
			40.22		25.73		77.9		31.1	
			40.83		26.67		79.9		34.2	
2022.01.02	34	16.49	39.10	40.21	30.01	28.14	73.5	77.1	44.4	38.2
			40.48		26.82		78.0		33.9	
			41.06		27.59		79.9		36.4	
2022.01.03	35	16.63	39.30	40.37	30.77	28.68	73.7	77.2	46.4	39.6
			40.63		27.35		78.0		35.2	
			41.18		27.91		79.8		37.0	
2022.01.04	36	16.72	39.40	40.46	31.15	29.00	73.7	77.2	47.4	40.3
			40.73		27.68		78.0		36.0	
			41.26		28.16		79.8		37.6	
2022.01.05	37	16.87	39.58	40.63	31.86	29.65	73.8	77.2	49.2	42.0
			40.91		28.37		78.2		37.8	
			41.40		28.72		79.7		38.9	
2022.01.06	38	17.02	39.71	40.76	32.50	30.33	73.8	77.2	50.8	43.7
			41.04		29.10		78.1		39.7	
			41.52		29.38		79.6		40.6	
2022.01.07	39	17.14	39.90	40.89	33.04	30.86	74.0	77.2	52.2	45.0
			41.15		29.69		78.0		41.2	
			41.63		29.86		79.6		41.7	

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 13 of 19

Date	Time(Day)	Cumulative CO ₂ production (g/vessel)					Percentage biodegradation (%)			
		Blank	Reference material		Sample		Reference material		Sample	
		Average	CO ₂	Average	CO ₂	Average	D%	Average	D%	Average
2022.01.08	40	17.27	40.14	41.05	33.59	31.40	74.3	77.3	53.6	46.4
			41.27		30.35		78.0		42.9	
			41.73		30.27		79.5		42.7	
2022.01.09	41	17.43	40.47	41.28	34.33	32.13	74.9	77.5	55.5	48.3
			41.46		31.27		78.1		45.4	
			41.91		30.80		79.6		43.9	
2022.01.10	42	17.50	40.57	41.37	34.52	32.33	75.0	77.6	55.9	48.7
			41.58		31.51		78.3		46.0	
			41.96		30.95		79.5		44.2	
2022.01.11	43	17.59	40.75	41.46	34.87	32.67	75.3	77.6	56.7	49.5
			41.58		31.96		78.0		47.2	
			42.05		31.19		79.5		44.6	
2022.01.12	44	17.71	40.95	41.59	35.26	33.09	75.6	77.6	57.6	50.5
			41.67		32.50		77.9		48.6	
			42.15		31.51		79.5		45.3	
2022.01.13	45	17.82	41.14	41.73	35.65	33.54	75.8	77.7	58.5	51.6
			41.77		33.14		77.9		50.3	
			42.27		31.84		79.5		46.0	

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Test Report

No. F690101/LF-CTSAYHA21-14746

Issued Date : 2022. 01. 27

Page 14 of 19

7.3 The curves of cumulative carbon dioxide production against time for the reference item (Figure 1) and test item (Figure 2)

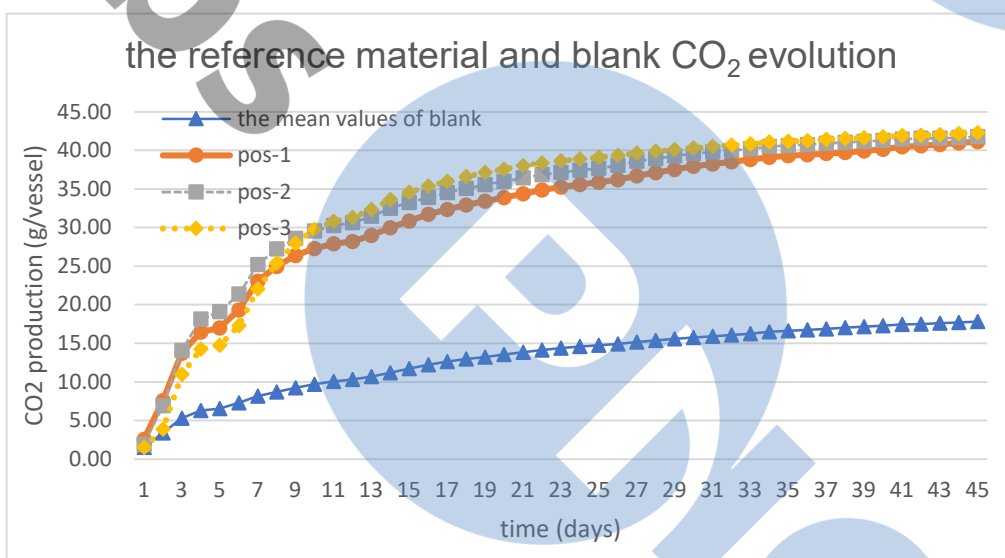


Figure 1. Reference item and blank (45 days) CO₂ evolution curve

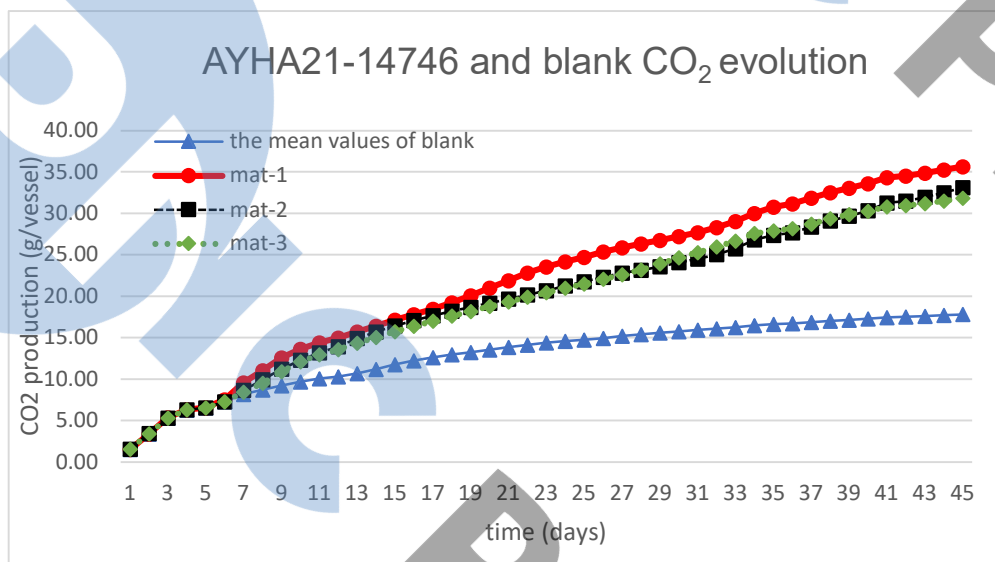


Figure 2. Test item and blank (45 days) CO₂ evolution curve

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

7.4 The curves of percentage biodegradation against item for the reference item (Figure 3, Figure 5) and test item (Figure 4, Figure 5)

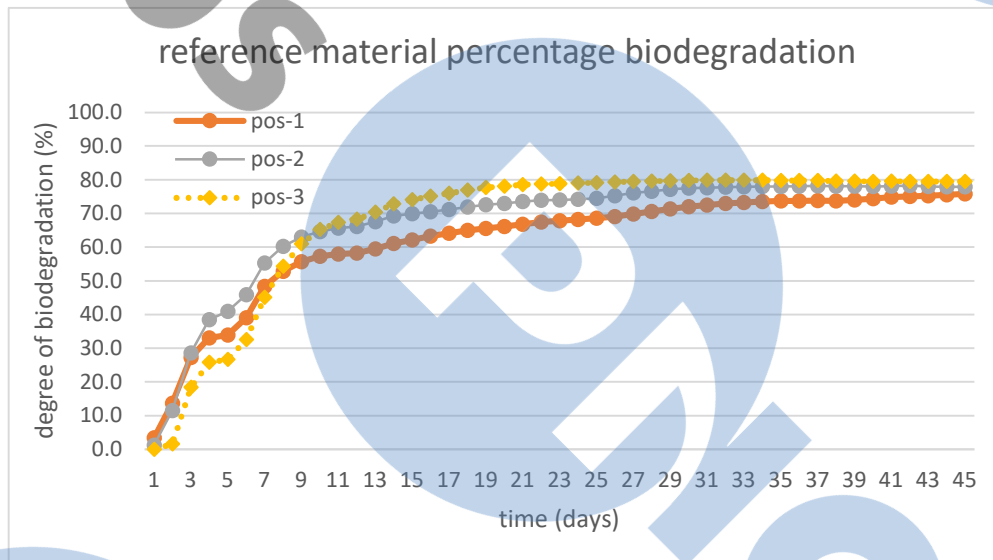


Figure 3. Reference item (45 days) percentage biodegradation curve

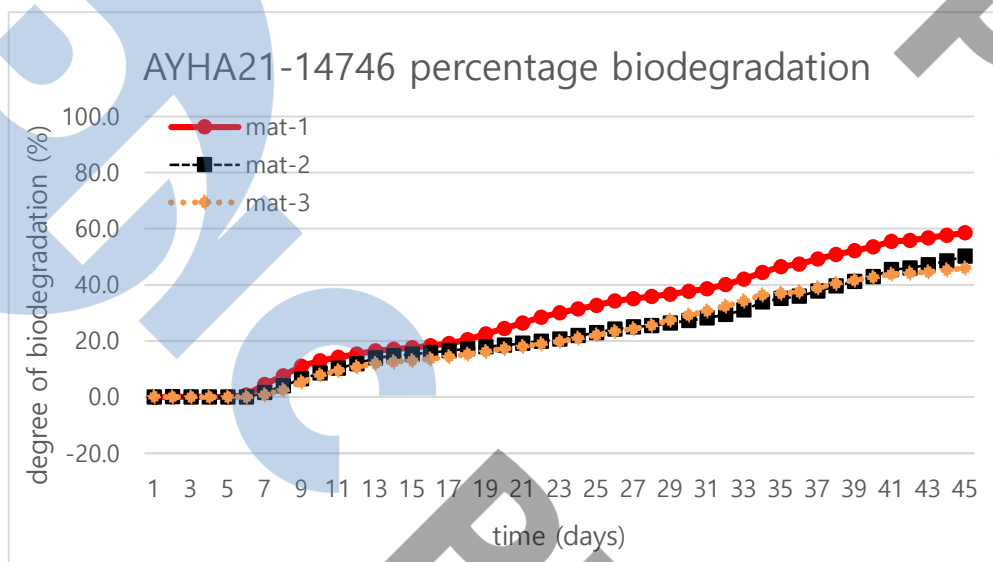


Figure 4. Test item (45 days) percentage biodegradation curve

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

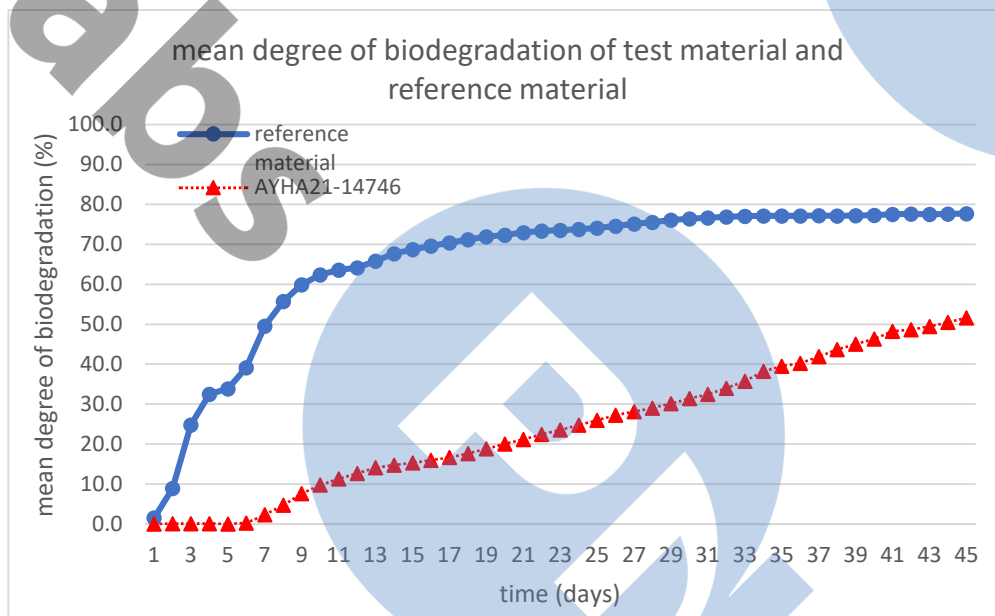


Figure 5. The mean values (45 days) of percentage biodegradation curve of reference item and test item

7.5 Results

- (1) Percentage biodegradation of three replicates of reference item was 75.8 %, 77.9 % and 79.5 % after 45 days of testing, respectively, and the mean value was 77.7 %. The differences between the individual values of three replicates of reference item were 2.4 %, 0.3 % and 2.3 %. All were less than 20%.
- (2) Percentage biodegradation of three replicates of test item was 58.5 %, 50.3 % and 46.0 % after 45 days of testing, respectively, and the mean value was 51.6 %. The differences between the individual values of three replicates of reference item were 13.4 %, 2.5 % and 10.9 %. All were less than 20%.

8. Quality Control

- (1) During the first 10 days of testing, the compost inoculum produced 120.2 mg CO₂ per gram of volatile solids, within the range of 50 to 150 mg CO₂ per gram of volatile solids.
- (2) The differences of percentage biodegradation between the individual values of three replicates for test items were less than 20% after 45 days of testing.
- (3) The percentage degradation of reference item was 77.7 % after 45th days of testing, greater than 70%.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

9. Guideline

ISO 14855-1:2012 Determination of the ultimate aerobic biodegradability of plastic material under controlled composting conditions – Method by analysis of evolved carbon dioxide – Part 1 : General method

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

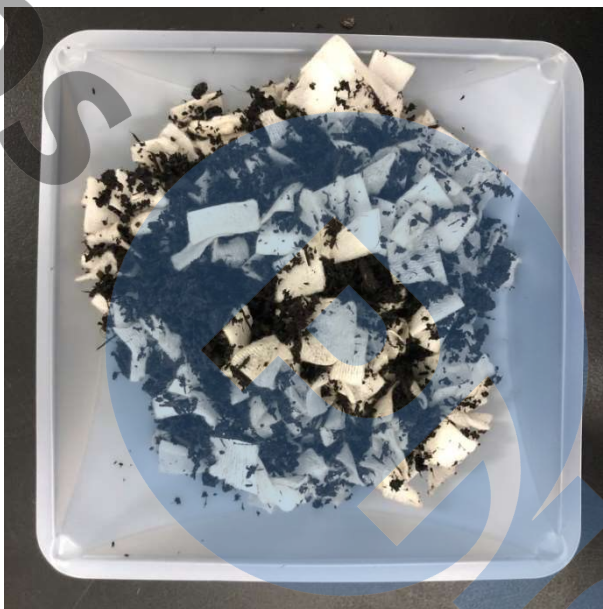
Picture of Sample as Received :



AYHA21-14746

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).

Picture of Sample and compost before test :



Picture of Sample and compost after test (45 days) :



AYHA21-14746

*** End of Report ***

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <https://www.sgs.com/en/terms-and-conditions/terms-e-document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s).