Number: HKGT05190149

TEST REPORT

Applicant: Date: Mar 17, 2021

Sample Description As Declared :

No. Of Sample	:	One
Sample Description	:	Yarn
Colour	:	White
Style No.	:	83/36
Product End Uses	:	Fabric
Fibre Content	:	100% Polyester

Applicant's Provided Care Instruction/Label : Jan 11, 2021

Original Sample Photo:

Figure 1: Test Sample

For any queries on this report, you are welcome to contact our customer service representatives:
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For and on behalf of
Intertek Testing Services Hong Kong Limited

Amy K.W. Wong
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1 Standard Test Method For Determination Of The Ultimate Anaerobic Biodegradation Under High-Solids Anaerobic-Digestion Conditions -- Method By Analysis Of Released Biogas (ISO 15985-2014):

PROJECT DESCRIPTION:

100% polyester yarn in white samples were submitted for testing under standard ISO 15985 : 2014. This test method covers the determination of the degree and rate of anaerobic biodegradation of plastic materials in high-solids anaerobic conditions. The test materials are exposed to a methanogenic inoculum derived from anaerobic digesters operating only on pretreated household waste. The anaerobic decomposition takes place under high-solids (more than 30 % total solids) and static non-mixed conditions. This test method is designed to yield a percentage of conversion of carbon in the sample to carbon in the gaseous form under conditions found in high-solids anaerobic digesters, treating municipal solid waste.

INOCULUM COLLECTION AND CONDITIONING

The anaerobic digested sewage sludge (Figure 2) mixed with household waste. To make the sludge adapted and stabilized during a short post-fermentation at 53°C, the sludge was pre-incubated (one week) at 53°C. This means that the concentrated inoculum was not fed but allowed to post ferment the remains of previously added organics allowing large easily biodegradable particles were degraded during this period and reduce the background level of biogas from the inoculums itself.

Figure 2: Anaerobic microbial inoculum

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INOCULUM PROPERTIES

A sample of the anaerobic digested sewage sludge was analyzed for pH, percent dry solids, and volatile solids, as well as, the amount of CO_2 and CH_4 evolution during the testing. Table 1 lists the results of this initial testing.

METHODOLOGY:

Inoculum Medium: Remove enough inoculum (approximately 15 kg) from the post-fermentation vessel and mix carefully and consistently by hand in order to obtain a homogeneous medium. Test three replicates each of a blank (inoculum only), Positive control (Reference material) (thin-layer chromatography cellulose), negative control (optional), and the test substance being evaluated.

Manually mix 1000 g wet weight (at least 20 % dry solids) of inoculum in a small container for a period of 2 to 3 min with 15 to 100 g of volatile solids of the test substance or the controls for each replicate. For the three blanks containing inoculum only, manually mix 1000 g of the same inoculum in a small container for a period of 2 to 3 min with the same intensity as was done for the other vessels containing test substance or controls. Determine the weight of the inoculum and test substance added to each individual Erlenmeyer flask accurately. Add the mixtures to a 2-L wide-mouth Erlenmeyer flask and gently spread and compact the material evenly in the flask to a uniform density.

After placing the Erlenmeyer flask in incubator, connect it with the gas collection device. Incubate the Erlenmeyer flasks in the dark or in diffused light at 52°C (62°C) for thermophilic conditions, The incubation time shall be run until no net gas production is noted for at least five days from both the Positive control (Reference material) and test substance reactors. Control the pH of the water used to measure biogas production to less than two by adding HCl.

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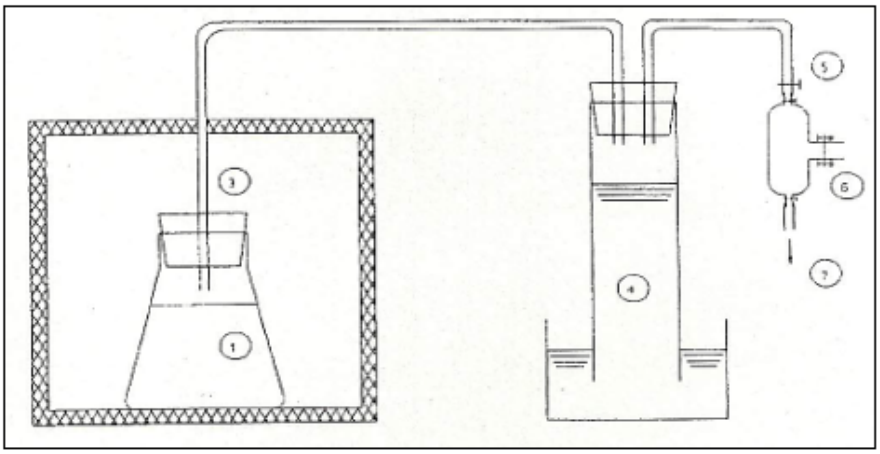
ANAEROBIC DIGESTER SETUP FOR THE PLASTIC BIODEGRADATION

The biodegradation testing of sample was performed in the digester as shown in the (Figure-3).



1. Digester
2. Incubator
3. Gas outlet
4. Gas collector
5. Valve
6. Gas Sampling
7. Gas Discharge

Figure-3: Digester setup

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RESULT:

The most important biochemical characteristics of the inoculum such as pH, Volatile Fatty Acids, NH4+-N— and dry solids were studied.

Table 1: Results of Initial testing of the anaerobic digested sewage sludge

Parameters	Requirement	Actual results
pH	7.5 to 8.5	7.52
Kjeldahl nitrogen	0.5 to 2 g/kg wet weight	1.40
Dry Solids at 105 ˚C	>20%	42.50
Volatile Solids at 550 ˚ C	Below 1 g/kg wet weight	0.75

The biogas volume in the gas sampling bag was measured (Table- 2). Presence of gas in the gas collector of Positive control (Reference material) indicated that the inoculum was viable and gas displacement was observed both in Positive control (Reference material) and Test Sample.

ISO 15985 states that for the test to be considered valid, the positive control (Reference Material) must achieve more than 70 % biodegradation after15 days with deviation less than 20%of the mean between the replicates.

Positive control (Reference material) showed 70.68% on 28th day with less than 20% of the mean difference between the replicates.

The gas displacement observed after 45 days is as shown in the table below.

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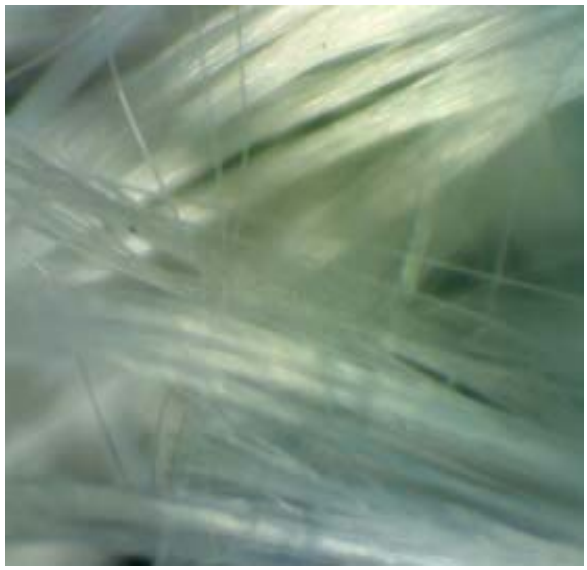
Table-2: Biogas volume of the evolved gas during the biodegradation process at 45 days

Biodegradation Test	Total Volume 45 days (mL)
Inoculum	3095
Positive control (Reference material)	9850
100% polyester yarn in white sample	5210

Colonization of bacteria at some places were observed under the microscope (Fig-4). This shows the process of biodegradation has begun.

(A)



(B)

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	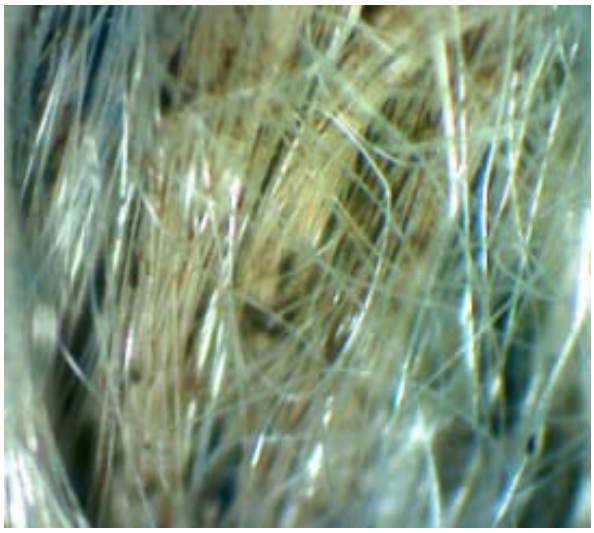
(C)	(D)

Figure 4: Microscopic image of Test samples Before and After 45 days Incubation Condition

A & B – Unexposed Test Sample 100% polyester yarn in white to anaerobic biodegradation process
C & D – Exposed Test Sample 100% polyester yarn in white to anaerobic biodegradation process

The percent biodegradation of Positive control (Reference material) and Test sample was calculated by the measured cumulative carbon dioxide and methane production from each flask after subtracting carbon dioxide evolution and methane evolution from the blank samples at the end of 90 days of testing. Calculations were based on Total Organic Carbon obtained of both Positive control (Reference material) and Test sample.

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Table-3: Percentage biodegradability of Test sample with respect to Positive control (Reference material) Cellulose.

Group	Inoculum control	Positive control (Reference material)	100% polyester yarn in white Sample
Weight	1000 ml	10.2012 g	10.1812 g
Total volume (ml)	3095.00	9850.00	5210.00
% CH_4	12.00	43.40	15.10
Volume of CH_4 (ml)	371.40	4274.90	786.71
weight of CH_4 (g)	0.2436	2.8043	0.5161
% CO_2	12.50	42.60	16.60
Volume of CO_2 (ml)	386.88	4196.10	864.86
Weight of CO_2 (g)	0.7660	8.3083	1.7124
Total weight of carbon in grams	0.3896	4.3465	0.8494
Theoretical weight of carbon in grams (Ci)	-	4.2916	6.3327
Biodegradation	-	0.9220	0.0726
% Biodegradation	-	**92.20**	**7.26**

Table 4: Percent weight loss of 100% polyester yarn in white sample.

Average Initial Weight (grams)	10.1812
Average Final Weight (grams)	10.0332
Percent Weight Loss (%)	1.45

The Percent weight loss was calculated based on the initial weight and final weight of the test sample after the 45 days study.

Biodegradation of the samples determined based on conversion of carbon from the test material to carbon in the gaseous phase (CH4 and CO2) can be observed in graph 1 and graph 2a & 2b.

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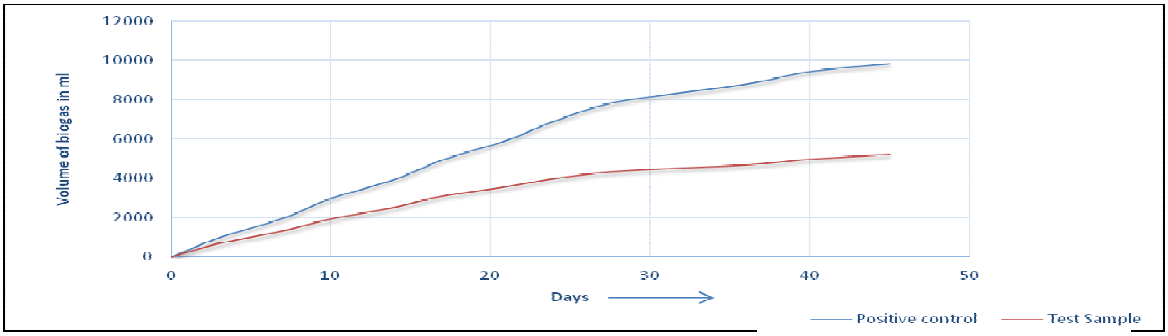
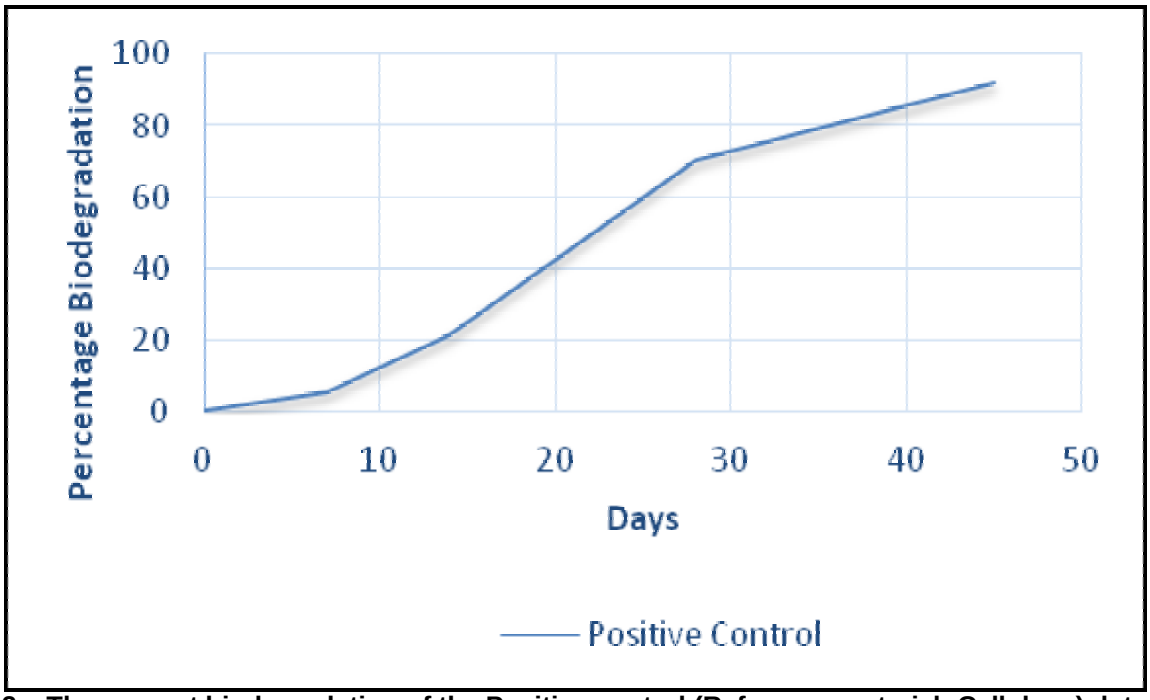


Graph-1: Plot showing Net Biogas Production from Test sample (100% Polyester yarn in white Sample) and Positive control (Reference material- Cellulose)



Graph-2a: The percent biodegradation of the Positive control (Reference material- Cellulose) determined based on conversion of carbon from cellulose to carbon in the gaseous phase (CH_4 and CO_2)

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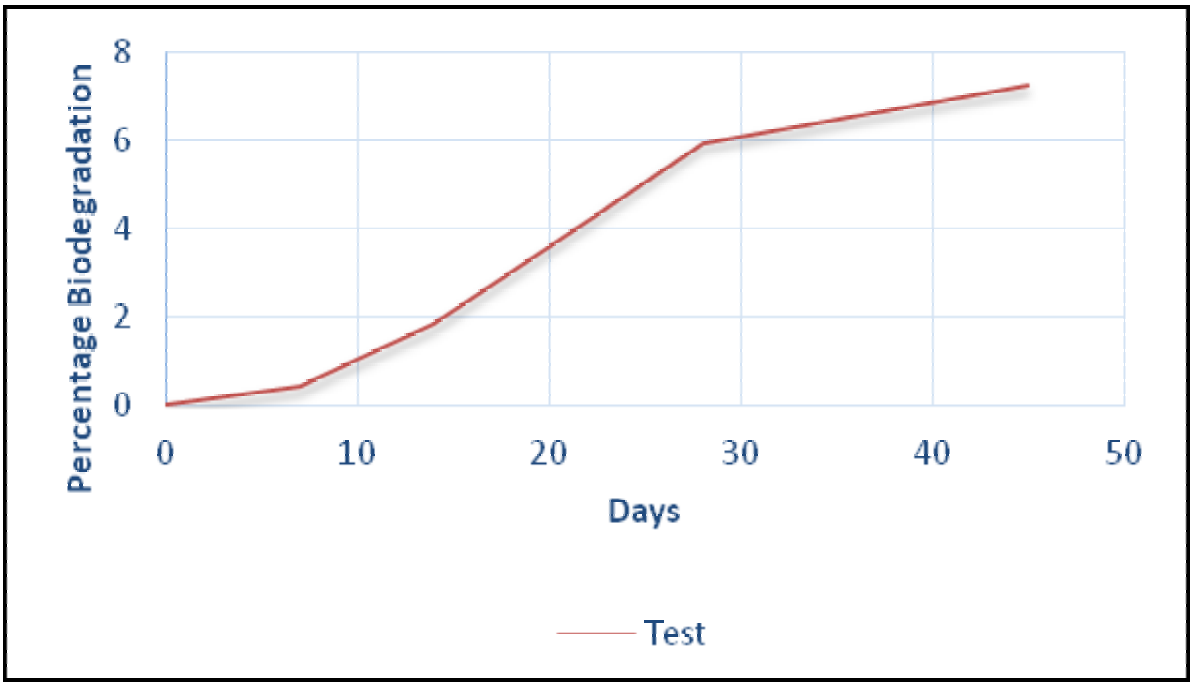

Graph-2b: The percent biodegradation of the Test sample (100% Polyester yarn in white Sample) determined based on conversion of carbon from the Test material to carbon in the gaseous phase (CH_4 and CO_2)

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CONCLUSION:

Considering the cumulative gas production as observed in Table 2 & 3 and its analysis indicates that the process of biodegradation has occurred in 100% Polyester yarn in white Sample. After 45 days of incubation, the level of biodegradation for the Positive control (Reference material) was 92.20 **%** while the 100% Polyester yarn in white Sample showed 7.26**%.**

Remark : The test was performed by an approved subcontractor laboratory which is part of the Intertek Group.

End of Report

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