Test Report Number: SZHH01996699

Applicant: GUANGZHOU HANDE NEW MATERIALS CO.,LTD.
NO. 161, YAOTIANHE STREET, YONGHE ZONE
GUANGZHOU ECONOMIC & TECHNOLOGICAL
DEVELOPMENT DISTRICT GUANGZHOU,
511356,CHINA

Date: Nov 29, 2024

Attn: Austin.Qian

Sample Description:
One (1) submitted sample said to be **sunesse sunscreen fabric**
Item No. : **Anaerobic Biodegradable Fabric**
Date Sample Received : Sep 09, 2024
Testing Period : Sep 09, 2024 ~ Nov 27, 2024

Tests conducted:
As requested by the applicant, refer to attached page(s) for details.

Authorized by:
For Intertek Testing Services
Shenzhen Ltd.

Rachel L. Guo
General Manager

Intertek Testing Services Shenzhen Ltd.
深圳天祥质量技术服务有限公司

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Tests Conducted

1 Anaerobic Biodegradation of Plastic Materials Under High-Solids Anaerobic-Digestion Conditions (ISO 15985:2014)

With reference to ISO 15985:2014 Plastics - Determination of the ultimate anaerobic biodegradation under high-solids anaerobic-digestion conditions - Method by analysis of released biogas.

1. Test information

Client	**GUANGZHOU HANDE NEW MATERIALS CO.,LTD.**
Name of Product	**Sunesse sunscreen fabric**
Sample Details	**Sunesse sunscreen fabric**
Quantity Received and Packing	500gms packing
Sampling Done by	Sample drawn and supplied by customer
Sample Registration Date	Sep 12, 2024
Analysis Starting Date	Sep 12, 2024 (pre-conditioning)
Analysis Completed on	Nov 22, 2024
Test Required	ISO 15985 Plastics - Determination of the ultimate anaerobic biodegradation under high-solids anaerobic-digestion conditions - Method by analysis of released biogas

2. Sample Receipt

The test sample was received on Sep 12, 2024 at the Intertek testing facility. The sample was sent through courier. The sample was at ambient temperature in good condition with no evidence of damage or contamination. No temperature preservation was required.

3. Sample Description

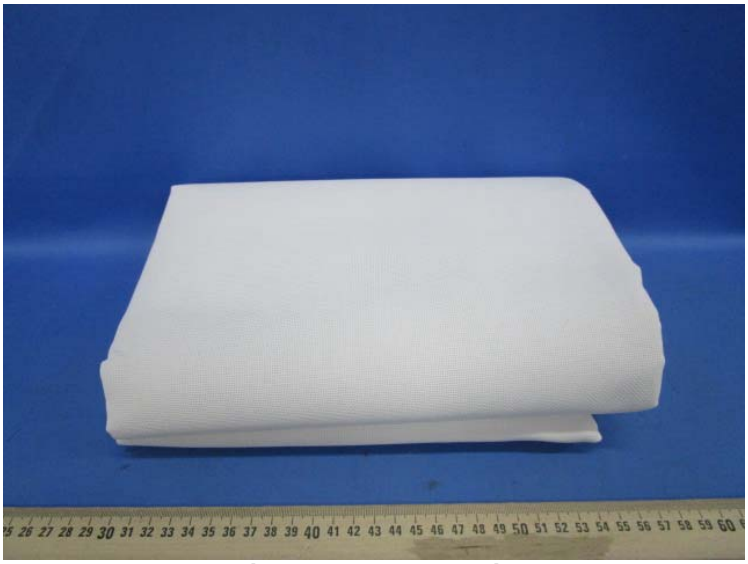

Figure 1 - Test sample

4. Project Description

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The test sample was submitted for testing under standard ISO 15985. 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.

5. Inoculum Collection and Conditioning

The anaerobic digested sewage sludge (Figure 2) mixed with household waste was obtained from the Chembur (Mumbai). 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

6. 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.

7. 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

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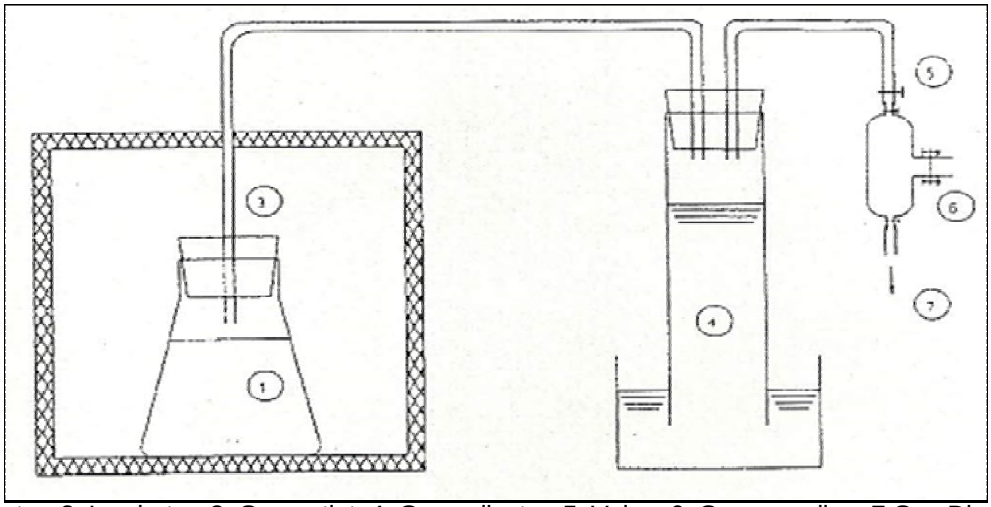
of a blank (inoculum only), Positive control (Reference material) (thin-layer chromatography cellulose), negative control (optional), and the test substance being evaluated.

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 (±2 °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.

8. 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

9. Result

The most important biochemical characteristics of the inoculum such as pH, Volatile Fatty Acids, NH_4^+-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	7.96
Kjeldahl nitrogen	0.5 to 2 g/kg wet weight	1.46
Dry solids at 105 °C	> 20%	44.00
Volatile solids at 550 °C	Below 1 g/kg wet weight	0.76

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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 after 15 days with deviation less than 20% of the mean between the replicates.

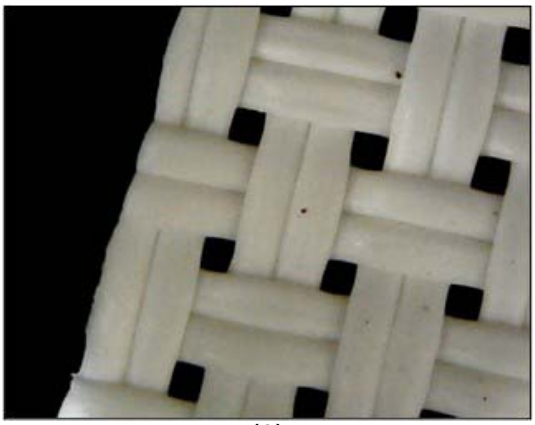
Positive control (Reference material) showed 70.37% on 27th day with less than 20% of the mean difference between the replicates.

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

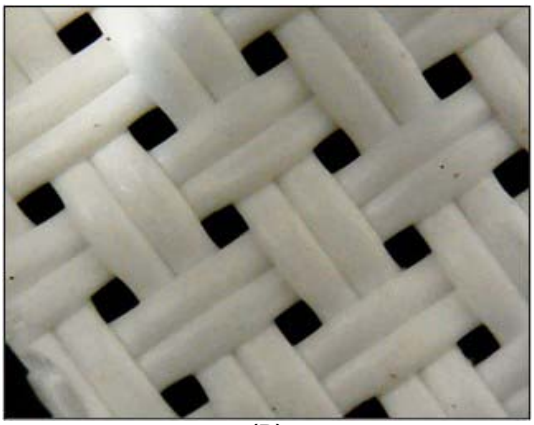
Table 2 - Biogas volume of the evolved gas during the biodegradation process at 45 days

Biodegradation Test	Total Volume (45 days) (ml)
Inoculum	2600
Positive control (reference material)	9750
Test Sample	4300

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



(A)



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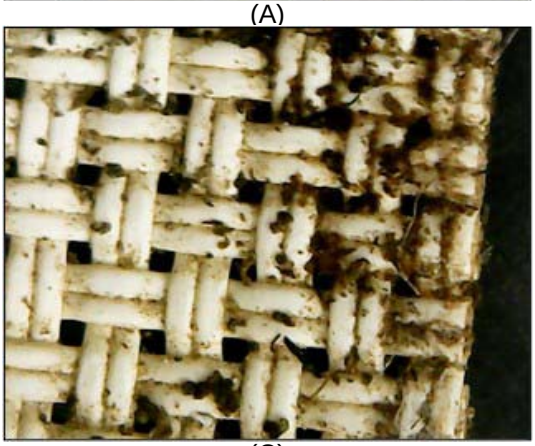
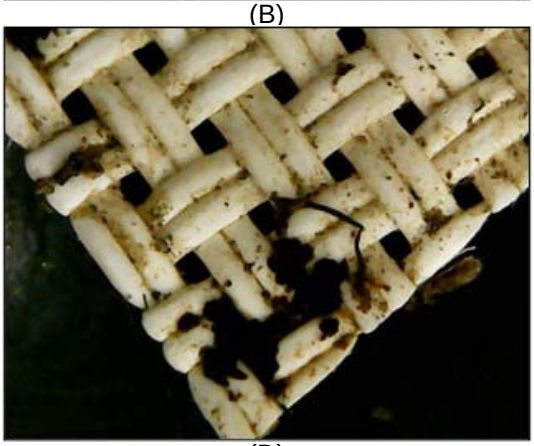


(C)



(D)

(A & B – Unexposed Test Sample to anaerobic biodegradation process;
C & D – Exposed Test Sample to anaerobic biodegradation process)

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Figure 4 - Microscopic image of test samples before and after 45 days incubation condition

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 45 days of testing. Calculations were based on total organic carbon obtained of both positive control (reference material) and test sample.

Table 3 - Percentage biodegradability of test sample with respect to positive control (reference material) cellulose

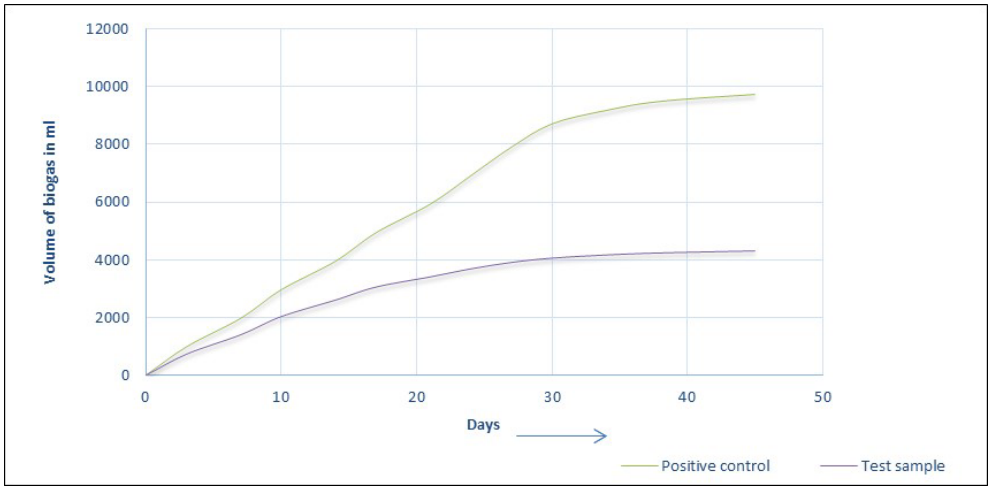
Group	Inoculum Control	Positive Control (Reference Material)	Test Sample
Weight	1000 ml	10.2483 g	15.4381 g
Total volume (ml)	2600.00	9750.00	4300.00
% CH_4	13.10	43.20	16.20
Volume of CH_4 (ml)	340.60	4212.00	696.60
Weight of CH_4 (g)	0.2234	2.7631	0.4570
% CO_2	15.90	43.40	17.50
Volume of CO_2 (ml)	413.40	4231.50	752.50
Weight of CO_2 (g)	0.8185	8.3784	1.4900
Total weight of carbon (g)	0.3886	4.3345	0.7450
Theoretical weight of carbon (Ci) (g)	-	4.3115	6.9408
Biodegradation	-	0.91521	0.05135
% Biodegradation	-	**91.52**	**5.14**

Table 4 - Percent weight loss of test sample

Average initial weight (g)	15.4381
Average final weight (g)	15.3284
Percent weight loss (%)	0.71

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 (CH_4 and CO_2) can be observed in Graph 1 and Graph 2a & 2b.



Graph 1 - Plot showing net biogas production from test sample and positive control (reference material - cellulose)

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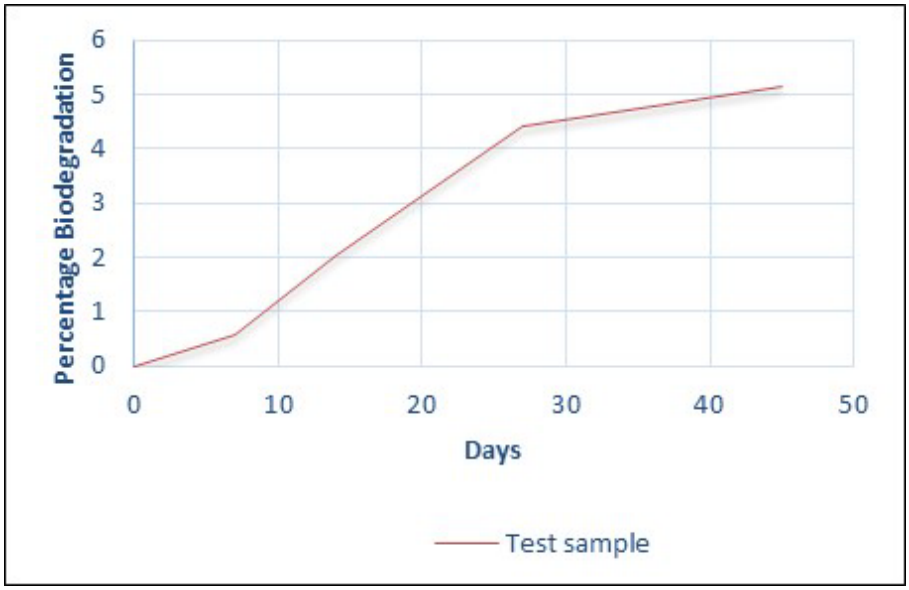
Graph 2a - The percent biodegradation of the positive control (reference material - cellulose) determined based on conversion of carbon from cellulose to carbon in the gaseous phase (CH_4 and CO_2)



Graph 2b - The percent biodegradation of the test sample determined based on conversion of carbon from the test material to carbon in the gaseous phase (CH_4 and CO_2)

10. Conclusion

Considering the cumulative gas production as observed in Table 2 & 3 and its analysis indicates that the process of biodegradation has occurred in the test sample. After 45 days of incubation, the level of biodegradation for the positive control (reference material) was **91.52%** while the test sample submitted showed **5.14%**.

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Tests Conducted

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

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End of report

*The statements of conformity reported have considered the decision rule agreed, namely that Intertek have taken account of measurement uncertainty as calculated by Intertek, and applied according to ILAC-G8/09:2019-(Non-binary acceptance based on guard band **w** = **U**) except designation from the customer, regulation or test specification. This decision rule only applies to the numeric test results. Full details of our agreed decision rules and the associated risk can be viewed: https://www.intertek.com.cn/diypage/upload/SZ-AP15-HLS-QA.pdf.*

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