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TEST REPORT

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Result:	TESTING COMPLETED	Report Date: 17-MAR-2011

Customer Name:	BPI
Tested To:	ASTM Standard D5511-2002
Description:	Green Genius Food Storage Bags
Test Type:	Biodegradability Testing
Job Number:	J-00091404
Project Number:	9090950
Project Manager:	Cheryl Navarro

Thank you for having your product tested by NSF International.

Please contact your Project Manager if you have any questions or concerns pertaining to this report.

Report Authorization: Digitally signed by Ata Ciechanowski
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Date: 2011.03.17 13:03:33 -04'00'

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Objective:

The objective of this test is to evaluate Green Genius food storage bags per the requirements of ASTM D5511 *"Standard Test Method for Determining Anaerobic Biodegradation of Plastic Materials Under High-Solids Anaerobic-Digestion Conditions"*.

Sample Description:

Testing was performed on plastic bags. The photograph in Figure 2 shows the plastic bag samples cut up in to small pieces of 2x2 cm.

Figure 1: Samples of Plastic Bag

Figure 2: Samples of 2x2 cm cut Plastic Bags for degradation experiment.

Test Protocol:

The degree of anaerobic biodegradation of plastic bags was performed per section 9.1 of ASTM D5511. The anaerobic digested organic sewage sludge was obtained from the Portage Lake Water and Sewage Authority in Houghton, Michigan. A sample of the anaerobic digested sewage sludge mixed with household waste 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.

Table 1: Sewage Sludge Properties

Property	Requirement	Actual
pH	7.5 to 8.5	7.8
Kjeldahl nitrogen	0.5 and 2g/kg wet weigh	7800 mg/L
Dry Solids at 105 degrees C	20%	16.7%
Volatile Solids at 550 degrees C	N/A	60% of dry solid

Each vessel was charged with approximately 1000 grams of pure anaerobic digested sewage sludge from a wastewater treatment plant that contained roughly 25 grams of dry inoculums. The following table shows the experimental charge of each vessel that contained approximately 25 g of the plastic bag samples.

Table 2: Experimental Charge

	Vessel #1	Vessel #2	Vessel #3
Anaerobic Digested Sewage Sludge (g)	1002.58	1005.48	1000.54
Cut Pieces of Plastic Bags(g)	25.00	25.01	25.01

The charged vessels were kept at 52^{o}C and maintained under diffused light. Cellulose was used as a positive control, polyethylene was used as a negative control, and pure anaerobic digested sewage sludge was used as a blank. The cellulose, polyethylene (PE), blank, and test sample were tested in triplicate. The cellulose used in this testing is a high purity cellulose powder of 20 micron size. It was purchased from Sigma Aldrich and has a catalog number S3504. The polyethylene used in this testing is a natural grade from Ineos Inc. with a product # K44-15-122.

A Micro-Oxymax respirometer from Columbus Instruments was used to monitor levels of carbon dioxide and methane volumes by the trapping device of each compost vessel. This information was used to calculate the amount of carbon dioxide and methane produced during the testing period. Based on this data, the cumulative amount of carbon dioxide and methane evolved from each vessel was calculated. This information was compared to the amount of CO_2 and CH_4 evolved from the blank specimens to determine the percent degradation. For detailed calculations, refer to ASTM D5511 Section 12.

Test Results:

The following graph shows the comparison of degradation of plastic bag samples with positive control - cellulose and negative control – polyethylene.

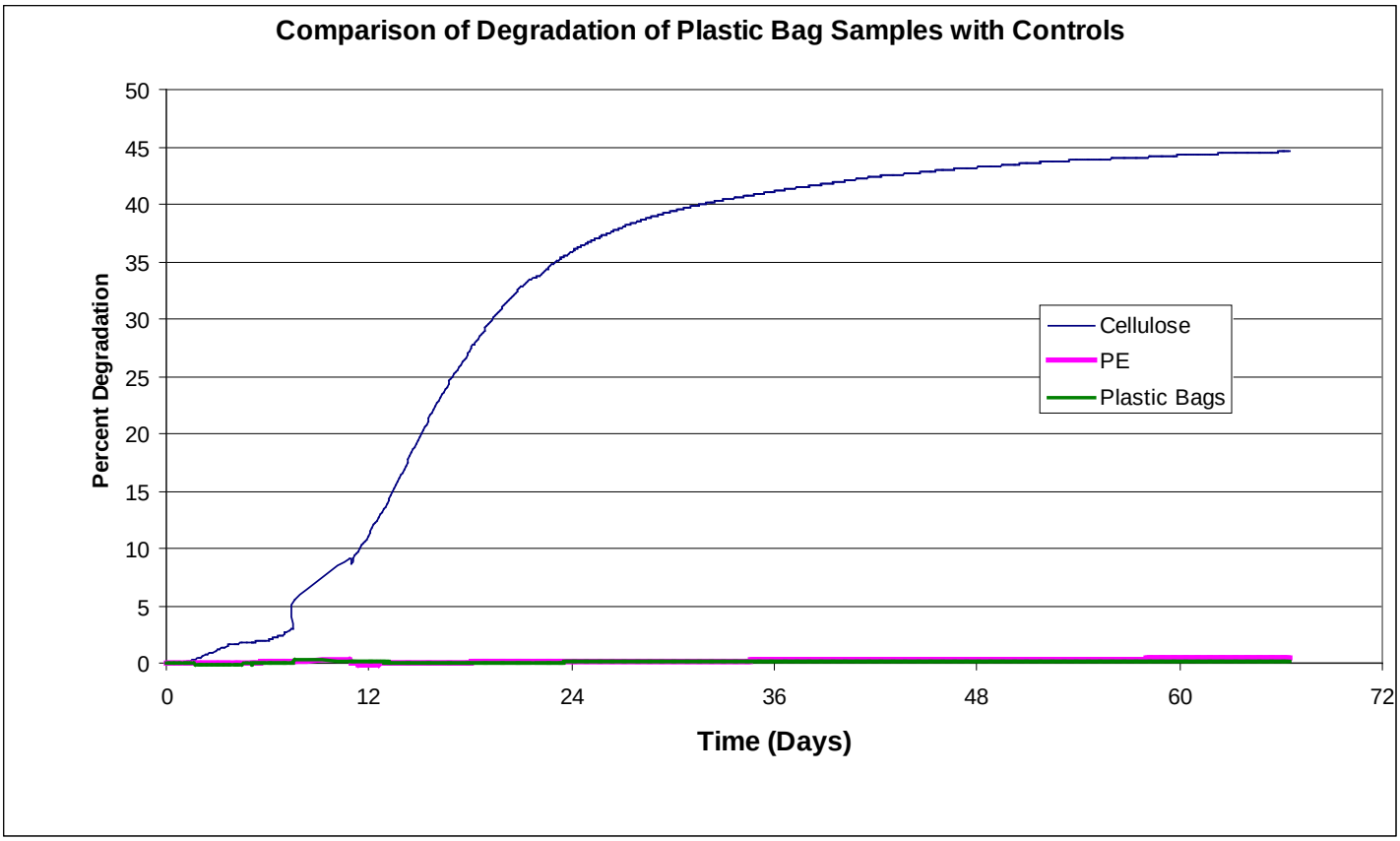

Figure 3: Comparison of Degradation of Plastic Bag Samples with Cellulose and PE Measured Under Similar Conditions as a Function of Time: Reference ASTM D5511.

The following table shows the percent degradation of cellulose at 15 days of testing. The average degradation of cellulose at 15 days was 22%.

Table 3: Degradation of Cellulose at 15 Days of Testing

Sample	**Percent Degradation of Cellulose**
1	20.82
2	23.85
Average	22.34

The following table shows the percent degradation of cellulose, polyethylene, and the plastic bag samples at the end of 60 days of testing. The percent degradation was calculated by the measured cumulative carbon dioxide and methane production from each sample after subtracting carbon dioxide evolution and methane evolution from blank samples at the end of 60 days of testing. Calculations were made based on total organic carbon of 81.11% for each vessel of plastic bags, 44.4% for cellulose and 85.7% for polyethylene.

Table 4: Carbon Dioxide and Methane Evolution at 60 days

Sample	**Plastic Bags Total CO_2 grams**	**Positive control (cellulose) Total CO_2 grams**	**Negative control (PE) Total CO_2 grams**	**Plastic Bags Total CH4 grams**	**Positive control (cellulose) Total CH4 grams**	**Negative control (PE) Total CH4 grams**	**% Degraded Plastic Bags samples**	**% Degraded of Positive Control Cellulose**	**% Degraded of Negative Control PE**
1	3549.9	13582.6	3102.6	1529.8	3505.7	1113.6	0.42	38.86	-1.56
2	3551.1	N/A	3702.5	1439.4	1370.9	1828.3	0.19	N/A	1.70
3	3494.6	14359.1	4049.2	1371.6	4837.7	1509.2	-0.13	49.76	1.03
Average							0.16	44.31	0.39

The following table shows a comparison of the amount of the plastic bag samples added to each chamber vessel prior to testing and the final amount of the sample retained after 60 days of testing. The plastic bag samples was separated from compost, passed through a 2 mm sieve, and then weighted.

Table 5: Comparison of the Initial and Final Amount of the Plastic Bag Samples

	Vessel #10	**Vessel #11**	**Vessel #12**
Amount of plastic bags added to vessel (g)	25.00	25.01	25.01
Amount of plastic bags retained after testing (g)	24.26	24.86	24.73

Conclusion:

Based on the above results, the positive control (cellulose) had degraded to approximately 44%, the negative control (polyethylene) had degraded to 0.39%, and the Green Genius food storage bag samples had degraded to 0.16%.

FTIR Analysis:

FTIR analysis was performed on a plastic bag sample. When compared with the FTIR spectra stored in the library of the equipment, it was found to have a match of 98.1% to high density polyethylene - see Annex A.

Annex A: FTIR Spectrum of the Green Genius Food Storage Bag Sample