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CERTIFICATION INTERNATIONAL
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ENVIRONMENTAL TECHNOLOGY VERIFICATION (ETV)

VERIFICATION STATEMENT (PART I: PHOTODEGRADATION)

TECHNOLOGY TYPE: **Plastic Carry Bags with Degradable Additive**

APPLICATION: **Solid Waste Management**

TECHNOLOGY NAME: **Filmex Biodegradable Plastic Bags (ETV 12-021)**

COMPANY: **Filmex Enterprises**

DATE: **July 2013**

Disclaimer

This ETV Statement is the result of an impartial, consensus-based approach to evaluating innovative environmental technology in accordance with the ETV Technical Protocol. The data presented are believed accurate and the analyses credible. The statements made and conclusions drawn regarding the product evaluated do not, however, amount to an endorsement or approval of the product in general or for any particular application nor a warranty to the performance of the technology that it will always operate as verified.

This ETV Statement is based from an evaluation activity supported by the DOST-ITDI ETV Group, the Panel of Experts, and Filmex Enterprises.

Mention of commercial product name does not imply endorsement.

This ETV Statement is a summary of the ETV Report of the **Filmex Biodegradable Plastic Bags (ETV 12-021)**

ETV TEST DESCRIPTION

The ETV Panel of Experts and *Filmex Enterprises* agreed to validate the claim that the addition of one percent **(2%) *MB Biomate BM-305 oxo-biodegradable additive*** in the formulation for the manufacture of high density polyethylene (HDPE) plastic carry bags will promote oxo-biodegradation under the degrading elements of the environment particularly ultraviolet (UV) light, temperature and water.

This ETV Verification Statement is focused on the first stage of degradation, which is *photodegradation.*

VERIFIED TECHNOLOGY DESCRIPTION

The following description of the **Filmex Biodegradable Plastic Bags** was provided by *Filmex Enterprises* and does not represent verified information.

The **Filmex Biodegradable Plastic Bags** *are made of high-density polyethylene (HDPE) plastic bags containing (2%) MB Biomate BM-305 oxo-biodegradable additive, supplied by First in Colours, Inc. (FIC). The addition of Biomate BM-305 promotes oxidative degradation in a process accelerated by light, heat, and stress. This results to a low molecular mass material that biodegrades to carbon dioxide (CO_2), water and biomass, which is not toxic and not harmful to the environment.*

VERIFICATION OF PERFORMANCE

The accelerated weathering exposure test following ASTM D5208-91 was adopted. Plastic bags with *(2%) MB Biomate BM-305 oxo-biodegradable additive* with a thickness of 15 microns were used as the experimental test materials. The control samples used in the validation were of the same specification in size, thickness and color but without the *MB Biomate BM-305 oxo-biodegradable additive*. The samples were labeled as FEA for the control samples and FEB for the samples containing *MB Biomate BM-305 oxo-biodegradable additive*.

Two sets of plastic strip samples were exposed to the Accelerated Weathering (UV) Conditions. The first set had a dimension of 250 millimeters (mm) x 15 mm and the second set was plastics strips with a size of 150mm x 70mm. Plastic samples with dimensions of 250 millimeters (mm) x 15 mm sizes were retrieved after 24, 48, 72, 96, 144, 168, 192, 216, and 240 hours of exposure for tensile-elongation test. While the retrieval of the plastic samples with dimensions of 150 mm x 70 mm was done after 48 and 168 hours for Fourier Transform Infrared Spectroscopy (FT-IR) Test.

Variation in tensile strength and mean elongation properties of plastic samples

A correlation between the degradability of the plastic bag with its exposure to UV/condensation conditions was obtained by the variation of tensile strength and elongation of the plastic films with respect to exposure time.

Figures 1 and 2 clearly show the effect of the accelerated weathering test to the tensile strength and elongation properties with increasing exposure time.

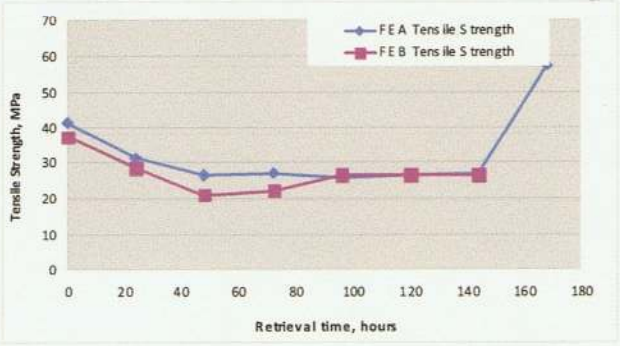

Figure 1. Mean tensile strength of plastic samples

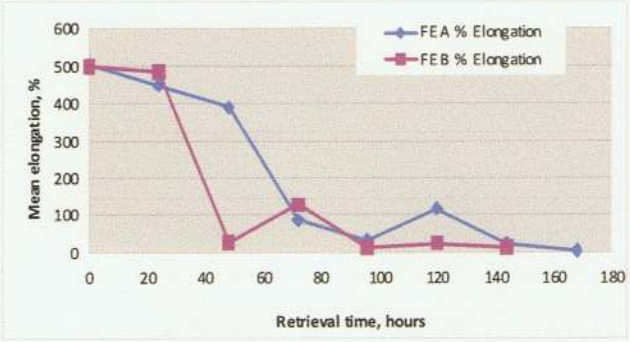

Figure 2. Percentage mean elongation before break of plastic samples

Generally, a decreasing trend in tensile strength and (%) elongation was observed for all plastic films as exposure time to UV is increased, as shown in Figures 1 and 2.

FTIR spectral analysis

In general, when PE undergoes degradation through chemical oxidation, the polymeric chain is oxidized, generating end fragments of carbonyl group (<C=O), ketones in specific. The absorption/transmittance bands of carbonyl compounds fall in the 1760-1670 cm^{-1} region of the FTIR spectrum. The presence/absence of the compound in the said spectrum region of the samples is summarized in Table 1.

Table 1. Presence of IR Region of Carbonyl Compound in the Plastic Film Samples.

	Frequencies (cm^{-1})					
Region (cm^{-1})	FEA unexposed	FEA 48	FEA168	FEB unexposed	FEB 48	FEB 168
1760 – 1670	-	-	-	-	+	-

Note: (-) means absence of Carbonyl compound; (+) means presence of Carbonyl compound

Based on the presented test results, the claim of Filmex Enterprises on their *Filmex Biodegradable Bags* has been verified as follows:

- **A decreasing trend in tensile strength and percent (%) elongation was observed for all samples with and without *BM-305 oxo-biodegradable additive* as exposure time to UV was increased.**

- **The (%) elongation before break of plastic films with *BM-305 oxo-biodegradable additive* has reduced by more than 95% after 96 hours exposure. This indicates that the required exposure period for the plastic samples with the additive before proceeding to Tier 2 or biodegradation test is 96 hours or 4 days.**

- **The (%) elongation of plastic samples with *the additive* significantly decreased after 48 hours of UV/condensation exposure while this only happened after 72 hours for the sample without the additive.**

- **The results also showed that the (%) elongation before break of the sample with additive is relatively lower than the sample without the additive as exposure time is increased except at exposure period of 24 and 72 hours which the results of both samples were comparable (i.e., there is no significant difference between samples with and without additive).**

- **The mean tensile strength and (%) elongation of unexposed plastic films with and without *BM-305 oxo-biodegradable additive* are comparable, i.e. there are no significant differences between unexposed samples with or without additive.**

- **There were no significant differences between the samples with and without the additive as exposure time increases in terms of tensile mean strength except at particular retrieval time of 72 hours.**

- **A significant difference between samples, with and without the additive as exposure time increases, can be observed in terms of (%) elongation before break except at 24, 72, and 144 hours exposures.**

- **The FTIR results of the samples with the *BM-305 oxo-biodegradable additive* exposed at 48 hours accelerated weathering exposure were able to show the detection of the accumulation and rate of oxidation degradation reaction of the materials.**