Republic of the Philippines
Department of Science and Technology
INDUSTRIAL TECHNOLOGY DEVELOPMENT INSTITUTE
DOST Cpd., General Santos Ave., Bicutan, Taguig City
Tel. Nos. : 837-2071 to 82 (DOST Trunklines) Telefax No.: 837-3167
http://www.itdibiz.com

ISO 9001:2000
CIP/4218/09/02/625

ENVIRONMENTAL TECHNOLOGY VERIFICATION (ETV)

VERIFICATION STATEMENT (PART II: BIODEGRADATION)

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

APPLICATION : **Solid Waste Management**

TECHNOLOGY NAME : **Plastic Bag with *Degradable Additive BDA* (ETV 08-011)**

COMPANY : **ESTA Trading Corporation and Prima Plastic Manufacturing Corporation**

DATE: **March 2010**

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, ESTA Trading Corporation and Prima Plastics Manufacturing Corporation. The implementation of this ETV was a joint undertaking of Prima Plastics Manufacturing Corporation, as manufacturer of plastics containing the additive, Degra... Additive BDA, and ESTA Trading Corporation as the supplier of the additive.

Mention of commercial product name does not imply endorsement.

The ETV Report/Statement must only be distributed/reproduced/quoted in full. No portion may be presented partially.

This ETV Statement is a summary of the ETV Report of the *Degradable Additive BDA* (ETV 08-011).

ETV TEST DESCRIPTION

The ETV Panel of Experts and the proponents agreed to validate the proponents' claim that plastic carry bags containing 1 percent (1%) *Degradable Additive BDA* will undergo degradation by microorganisms after initially been subjected to photodegradation.

This ETV Statement is focused on the second stage of degradation, which is biodegradation.

VERIFIED TECHNOLOGY DESCRIPTION

The following description of *Degradable Additive BDA* was provided by the proponents and does not represent verified information.

> *"The Degradable Additive BDA (Figure 1) is a multi-stage degradable plastic additive that can help in the breakdown of plastic bags first by photo degradation and oxidation and later by biodegradation.*
>
> *Degradable Additive BDA when added to the polymer resin during the manufacture of plastic bags can trigger the breakdown of plastic bags approximately 90 days onward. Degradation, which reduces the molecular weight of the plastic product, is composed of two (2) processes: photo degradation and oxidation. Photo degradation is the breakdown of the plastic product by UV light from the sun while oxidation takes advantage of the thermal energy and time to degrade the plastic.*
>
> *After undergoing degradation, further breakdown of the plastic occurs through the second stage, biodegradation. This is brought about by its exposure to different naturally produced substances by microorganisms and other living organisms. The end products are H_2O (gas) and CO_2 (gas)."*

VERIFICATION OF PERFORMANCE

Plastic bags with 1% *Degradable Additive BDA*, of size 12, with a thickness of 30 microns and printed with the SM plastic bag label were used as the experimental test materials. The control samples used in the validation were of the same size, thickness and color but without the *Degradable Additive BDA*.

Samples used for the biodegradation test are those that were initially subjected to the accelerated weathering exposure test using the Suga Ultraviolet (UV) Dew Panel Light Control Weather Meter. Table 1 provides the conditions and parameters for the UV/condensation exposure prior to the biodegradability test.

The ETV Report/Statement must only be distributed/reproduced/quoted in full.
No portion may be presented partially.

Table 1. UV Exposure Conditions

Parameter	Conditions
Duration (UV)	20 hours @ 50°C ± 3 (UV lamps ON)
Duration (Condensation)	4 hours @ 40°C ± 3 (UV lamps OFF)
Duration of Exposure	268 hours
UV lamp	Type A (340 nm)
Irradiance	0.72 W/m^2/nm or equivalent
Cycle	24-hour cycle: 20 hours UV, 4 hours condensation (dew)

Samples with and without the *Degradable Additive BDA* with size 101.6 millimeters (mm) x 25.4 mm were exposed to these stated conditions and retrieved after 268 hours for consequent biodegradability testing.

The biodegradability test was based on ASTM D5247-92 or Standard Test Method for Determining the Aerobic Biodegradability of Degradable Plastics by Specific Microorganisms. The method involves testing the degradation of sterile plastic sheets in submerged pure culture aqueous medium under aseptic and controlled conditions. For this test, two types of microorganisms were tested in separate pure culture mediums: *Phanerochaete chrysosporium*, a fungi and *Streptomyces*, a bacterium. Both are lignin degraders that are common to forest litter and composting sites.

Table 2 is a summary of the test conditions for the biodegradability test.

Table 2. Biodegradation Testing Conditions

Parameter	Description
Test organism	*Phanerochaete chrysosporium and Streptomyces* (in separate pure culture medium)
Culture medium	Potato dextrose broth
Shaking period	Continuous
Shaking speed	125 rpm
Incubation period	30 days
Incubation temperature	30°C

The use of the un-inoculated controls allows for the separation of degradable plastic changes due to incubation condition from those that are the results of biological activity. Weight loss of the un-inoculated and inoculated samples was compared. Weight loss may imply that the test organisms used were able to act on the test samples.

Following the biodegradability test, the residual plastic sheets were analyzed through Scanning Electron Microscopy (SEM) to observe any changes in the surface structures of the plastic sheets before and after the biodegradation test.

All plastic samples showed evidence of physical degradation after 30 days of microbial incubation. However, weight loss data were inconclusive because of bacterial or fungal cell mass accumulation on the films. The tests conducted were also limited to the measurement of weight

The ETV Report/Statement must only be distributed/reproduced/quoted in full.
No portion may be presented partially.

loss. Determination of molecular weights was not conducted. Furthermore, though the microorganisms used in this biodegradability test are those that are commonly available in the natural environment, it should be noted that plastic samples not significantly degraded in this test may degrade at acceptable rates in a natural environment under mixed microbial conditions.

Though quantitative weight loss data were inconclusive, these data paralleled the SEM micrographs, except for the samples with the additive that was incubated with *Phanerochaete chrysosporium*. SEM observations showed that the plastic films without the additive have a relatively smooth surface even after incubation with microorganisms for 30 days. Similarly, the sample with the additive and without the microorganism showed a homogeneous surface morphology. In contrast, plastic films with *Degradable Additive BDA* exposed to the *Streptomyces* for 30 days showed an apparent disruption and agglomeration of the surface. On the other hand, although samples with the additive exposed to *Phanerochaete chrysosporium* showed weight loss after 30 days, SEM results demonstrated no significant change in surface structure.

Based on SEM results, changes in surface morphology after incubation with *Streptomyces* may suggest microbial action on the samples.

Based on the above test results, the claim of *ESTA Trading Corporation and Prima Plastic Manufacturing Corporation* on plastic bags with *Degradable Additive BDA* has been verified as follows:

That changes in surface morphology of the plastic films with 1% *Degradable Additive BDA* after incubation with *Streptomyces* for 30 days may suggest microbial action. However, the extent and rate of biodegradation cannot be directly quantified using the methods employed in this ETV.

The ETV Report/Statement must only be distributed/reproduced/quoted in full.
No portion may be presented partially.