ECOPLUS™: Making Greener Environment Our Business

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Introduction

It was estimated that the world plastic consumption in 2003[1] to be around 145.1 million metric ton with polyethylene accounting for 60 million ton. 60% of that total amount goes into packaging application such as carrier and shopping bags including high density (HDPE), linear low density (LLDPE) and low density polyethylene (LDPE).

With polyethylene demand (per capita) increasing across the globe i.e. in the last 20 years (since 1984) the demand has increased from more than 80% in North America and Europe to more than 300% in the Far East, it is no wonder that this would have certain impact to the environment.

Numerous effort have been taken by various orgainisation either governmental or non governmental including introduction of recycling, reducing and reusing program as well as imposing certain levy on plastics packaging have led to various degree of success. Nonetheless, one of the key concerns that has been extensively discussed and debated is the after use/ disposal issue. In most countries, the widely (probably the cheapest option in some countries) used method is in the form of landfilling and in most developed countries, incineration seemed to be the acceptable and preferred option even though these options may present different concerns.

As most of us are aware, polyethylene is chemically stable in nature and is made up primarily of hydrocarbon molecules and this does not easily degrade under ambient condition. In most cases, it is inert towards alkalis and acids and its covalent bond requires high level of energy to break it or initiate the process of degradation i.e. 330 to 350 kJ/mol.

With the recent development in area of plastic degradability, it presents an alternative method of disposing used plastic packaging. The current approach is to introduce pro degradant additive masterbatch via additive formulation during the process of plastic fabrication. *See Diagram 1*

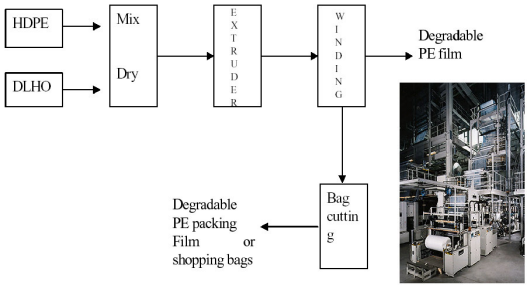


Diagram 1

What is ECOPlus™ 105?

ECOPlus ™ 105 High Density Polyethylene (HDPE) was designed to meet the growing demand of plastic degradability. ECOPlus™ 105 HDPE complies with ASTM 883 – 00 on the definition of degradable plastics, meaning

> *The fabricated plastic product made from ECOPLUS™ 105 Degradable PE, when exposed to specific environment and/ or condition, the process of degradation will take place and propagate leading to eventual disintegration.*

Polyethylene in its unaltered form does not easily degrade under the influence of either UV or heat within the stipulated time span.

However, by incorporating specific additive known commonly as pro degradant additive, the process of degradation under the action of either UV, heat, oxygen and/or mechanical shear will take place through formation of free radicals and thereafter leading to the chemistry of chain scissioning. Physically, it can be seen that the end product will disintegrate. *See Diagram 2*

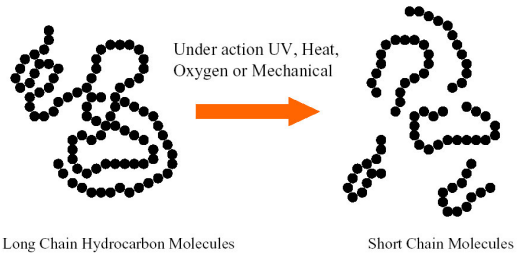


Diagram 2

ECOPlus™ 105 HDPE is leading the degradable plastic industry by taking the approach to the next level i.e. by incorporating a pro degradant additive during the resin production process thus eliminating concerns such as inaccuracy in additive dosing and homogeneity. With the advance in the compounding technology, the pro degradant

[1] *CIMAI Report 2003*

additive can be thermally added during the process of compounding in its active form.

This is essential in ensuring that the pro degradant additive does not prematurely consumed during this stage, which could lead to adverse performance. *See Diagram 3*

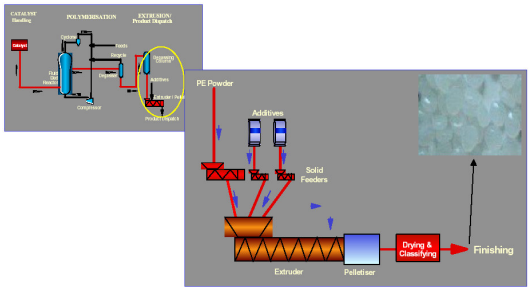


Diagram 3

The unique process (patent pending) is probably among the first attempt in the world to introduce a pre-mixed resin, which incorporated a pro degradant additive.

The following information entails laboratory evaluation of ECOPlus™ 105 HDPE according to known international standard and specification including 3rd party laboratory evaluation.

ECOPlus ™ 105 HDPE Technical Performance

i. EU Directive for Additive Migration[2] (EN1186 Part 2 & 3)
The samples made from ECOPlus™ 105 HDPE have been immersed in 2 different food simulants as per method. The following results show the outcome of the test. *See Table 1*

Food Simulants	Unit	Results	Criteria
Aqueous	mg/dm^2	< 1.0	< 10
Olive Oil Fatty	mg/dm^2	< 1.0	< 10

Table 1

The result concludes the compliance of ECOPlus ™ 105 HDPE with EC Directive on additive migration in food contact requirement.

ii. Accelerated Weathering Performance[2]
Samples made from ECOPlus™ 105 HDPE has been subjected to the following test method:

ASTM D2565: 1999 Cycle No.1 for 750 hours: Xenon Test (simulating 6 months worldwide exposure)

The outcome can be exemplified in the following photographs depicting degradability performance. *See Diagram 4*

Before ageing | After 750 hours ageing

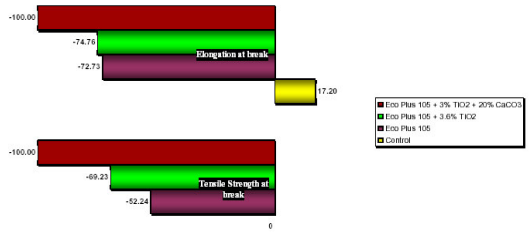
Diagram 4

The RAPRA evaluation and report concludes the degradability performance of ECOPlus™ 105 HDPE under action of UV

iii. Heat Ageing Performance
Samples made from ECOPlus™ 105 HDPE has been tested under the following condition:

Thermal ageing in air circulated oven at temperature of 70°C for a duration of 250 hours. 4 types of samples with various industrial formulations were used and compared against the control sample[3].

The outcome from the ageing performance can be shown through percentage deviation in end product properties and in this case, tensile properties such as elongation at break and tensile strength at break. The results are as follows:



Note that the addition of other additives such calcium carbonate and white masterbatch (titanium dioxide) are made via dry blending of Eco Plus with the mentioned additives at the converters machine.

[2] *Tests were carried out in RAPRA Technology, UK*
[3] *Control Sample here is a high density polyethylene (HDPE) typically used in fabrication of packaging bags having density of 950 kg/m3 and melt flow index of 0.1 g/10min on 2.16kg load*

The result concludes the performance of ECOPlus™ 105 HDPE under heat and its varying performance with different formulation. The product showed initial signs of degradation through loss in product properties.

iv. Eco Labeling Scheme Compliance[4]

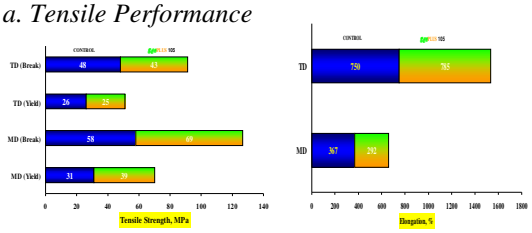
Products made from ECOPlus™ 105 HDPE has been awarded Malaysia's First Eco Labeling Certification which require among other things, the degradability performance. This is important in assuring the users the product performance.

v. Evaluation of end product performance (before use).

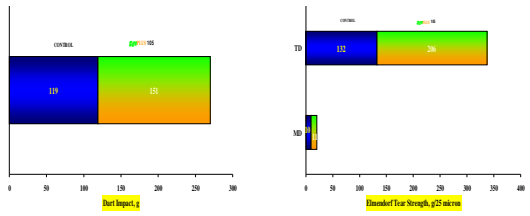
To ensure that the product made from ECOPlus™ 105 HDPE meet the intended requirement of the application, specific tests such as:

a. Tensile Performance
b. Impact Performance and Tear Strength Performance

a. Tensile Performance



b. Impact and Tear Strength Performance



The above results have shown that in comparison with a typical HDPE packaging material, ECOPlus™ 105 HDPE meet the intended performance and requirement of end products at the same thickness.

Recommendation

In conclusion, ECOPlus™ 105 HDPE have shown that it meets the requirement of degradability as well as food contact performance. With the demand for the usage of degradable plastic is expected to grow in the near future, it is important that joint efforts and collaboration among the plastic industries players would ensure sustainability in achieving greener environment.

"Together, We Make Greener Environment Our Business"

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[4] *Sirim QAS is Malaysia's National Standard/ Specification & Accreditation Body*