



D5-FILM09

AF 0900

AF-0900 is a 100% biodegradable variant of Advanced Poly's most popular film. AF 0900 uses an environmentally-friendly degradation process that permits the material to be digested by natural-occurring soil microorganisms, leaving no distinguishable polyethylene or toxic residue. Extruded in-house at Advanced Poly's production facility in Akron, Ohio, this film is tailored for the customer's Industrial or FDA applications. No matter the application, this film offers outstanding strength with test results far exceeding typical low-density blends. In many cases, the results are double the elongation and dart impact of comparable film and film thicknesses. This offers customer the ability of down-gauging while achieving required product protection.

The D5-FILM09 is suitable for FDA and industrial-grade applications where biodegradability is desirable, and is available in Clear, Green Tint, Opaque White, Opaque Black, with or without printing.

| | |
|--------------|-------------------|
| APP P/N: | D5-FILM09-2-Black |
| Application: | Industrial, FDA |
| Color: | Opaque Black |

| | |
|--------------|-----------------------|
| APP P/N: | D5-FILM09-2-Clear-PRT |
| Application: | Industrial, FDA |
| Color: | Opaque Black Printed |

| | |
|--------------|--------------------|
| APP P/N: | D5-FILM09-2- Clear |
| Application: | Industrial, FDA |
| Color: | Clear |

| | |
|--------------|-----------------------|
| APP P/N: | D5-FILM09-2-Clear-PRT |
| Application: | Industrial, FDA |
| Color: | Clear Printed |

| | |
|--------------|-------------------|
| APP P/N: | D5-FILM09-2-Green |
| Application: | Industrial, FDA |
| Color: | Green Tint |

| | |
|--------------|-----------------------|
| APP P/N: | D5-FILM09-2-Clear-PRT |
| Application: | Industrial, FDA |
| Color: | Green Tint Printed |

| | |
|--------------|-------------------|
| APP P/N: | D5-FILM09-2-White |
| Application: | Industrial, FDA |
| Color: | Opaque White |

| | |
|--------------|-----------------------|
| APP P/N: | D5-FILM09-2-Clear-PRT |
| Application: | Industrial, FDA |
| Color: | Opaque White |



Applications: Hardware / industrial components, medical, dental, foods, printed bags. Available treated for flexo printing, thermal, hot stamp, or label application.

Specifications:

| Properties | Typical Values | | | |
|---------------------------------|----------------|---------|---------|---------|
| | 1.5 mil | 2.0 mil | 3.0 mil | 4.0 mil |
| Haze (%) | 9.4 | 12.5 | 16.6 | 18.8 |
| Gloss at 45° | 64 | 58 | 50 | 47 |
| Dart Impact (g/mil) | 45 | 69 | 49 | 56 |
| Ky Puncture (g/mil) | 14 | 22 | 27 | 19 |
| Utility Tensile Strength (MPa) | 31 | 34 | 32 | 30 |
| Elmendorf Tear Strength (g/mil) | 430 | 370 | 340 | 285 |
| Elongation (%) | 1,100 | 1,100 | 1,290 | 1,330 |

Available Colors:

| D5-FILM09-2-Opaque Black | D5-FILM09-2-Green Tint | D5-FILM09-2-Opque White |
|--|--|--|
|  |  |  |

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THIS IS TO CERTIFY THAT

Advanced Poly-Packaging Inc.

A company registered in Ohio, USA
under registration number 77-152-1796

is an authorised User of



Controlled-life Plastic Technology

Signed on behalf of
Symphony Environmental Ltd

Director

Company Secretary

Certificate Number
0911027

Date of issue
23rd November 2009



ISO 9001-2008



Oxo-biodegradable
Plastic Association



Market of London
Stock Exchange



Society of Plastics
Engineers (US)



Green Apple
Award



ASTM
Standards Worldwide



Society of the
Chemical Industry
(UK)



Millennium
Award

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Date: 23 November 2009

TEST REPORT No: Advanced Poly-Packaging, Inc. (1481)



Certificate No. FM37939

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A wholly owned subsidiary of Symphony Environmental Plc.

SYMPHONY ENVIRONMENTAL LTD

TOTALLY DEGRADABLE PLASTICS

TEST REPORT No: Advanced Poly-Packaging, Inc. (1481)

1.0 AIMS

To compare the oxo degradable response of polyethylene film samples containing a prodegradant additive with respect to a non degradable control sample by means of an accelerated UV ageing test.

2.0 CONCLUSIONS

The results of the UV ageing test demonstrate that the film sample containing the d₂w prodegradant additive has degraded to a greater extent than the control sample.

The film containing the additive demonstrates a larger change in carbonyl optical density measurement than the respective control film at the conclusion of the test (Figure 1). This result is consistent with the film containing the prodegradant additive being in a more advanced state of degradation.

The sample containing d₂w reached a carbonyl optical density value of 0.0108 and 0.0083 after 440 hours UV ageing; the control sample without additive demonstrated an increase in carbonyl optical density of only 0.0054.

This result is consistent with inclusion of d₂w promoting degradation in the film sample.

3.0 SAMPLE DESCRIPTION

| | |
|-------------------|---|
| Supplier name: | Advanced Poly-Packaging, Inc. |
| Polymer type: | PE |
| Samples provided: | A) 70µm Clear film with d ₂ w oxo-biodegradable additive B) 73µm White film with d ₂ w oxo-biodegradable additive C) 71µm Control Clear film without additive |
| Additive system: | 93283 |

4.0 TEST PROTOCOL

The method involves subjecting the substrate to accelerated UV ageing in an ARTACC Bandol Wheel apparatus and monitoring degradation as function of ageing time via changes in the carbonyl optical density ($\Delta 1713\text{cm}^{-1}$) as determined by FT-IR (Fourier Transform Infra Red) spectroscopy.

Measuring changes in carbonyl optical density is a useful technique for monitoring the rate of degradation of the sample. Carbonyl species (aldehydes, ketones, carboxylic acids etc.) are reaction by-products of the oxidative degradation process and as such their accumulation are indicative of the rate of degradation.

The carbonyl optical density method has the added advantage in that it allows direct correlation with the mechanical properties of the samples. An optical density of 0.001 is typically equivalent to an Elongation at Break (EaB) reduction of 50% in the sample, whilst a value of 0.01 equates to an EaB value of a 5%.

ASTM D5510: Standard practice for heat ageing of oxidatively degradable plastics, defines degradation in terms of an embrittlement endpoint at which the sample has achieved an elongation at break value of 5%. It thus follows that when a sample achieves a carbonyl optical density of 0.01 it is similarly embrittled.

5.0 TEST METHODOLOGY

5.1 Accelerated UV Ageing-Bandol Wheel

Samples of product were exposed to accelerated UV ageing within an ARTACC Bandol Wheel H400 accelerated weathering apparatus (SEVAR sarl.). The samples were placed in a specially designed holder and mounted in a circular sample rack in which traces a circular path around a 400W air cooled low pressure mercury discharge lamp (Borosilicate filter). The lamp provides an irradiance of 105 W/m^2 at wavelengths between 290 and 400nm.

The period of each cycle was 4 hours with 84% of the time exposed to dry, light conditions and 16% exposed to wet, dark conditions (water immersion of sample). Test temperature as measured by a black body thermocouple was 60°C . Samples of the additive and control materials were withdrawn every 40 hours and their carbonyl optical density determined by FTIR spectroscopy.

5.2 Carbonyl Optical Density Measurement

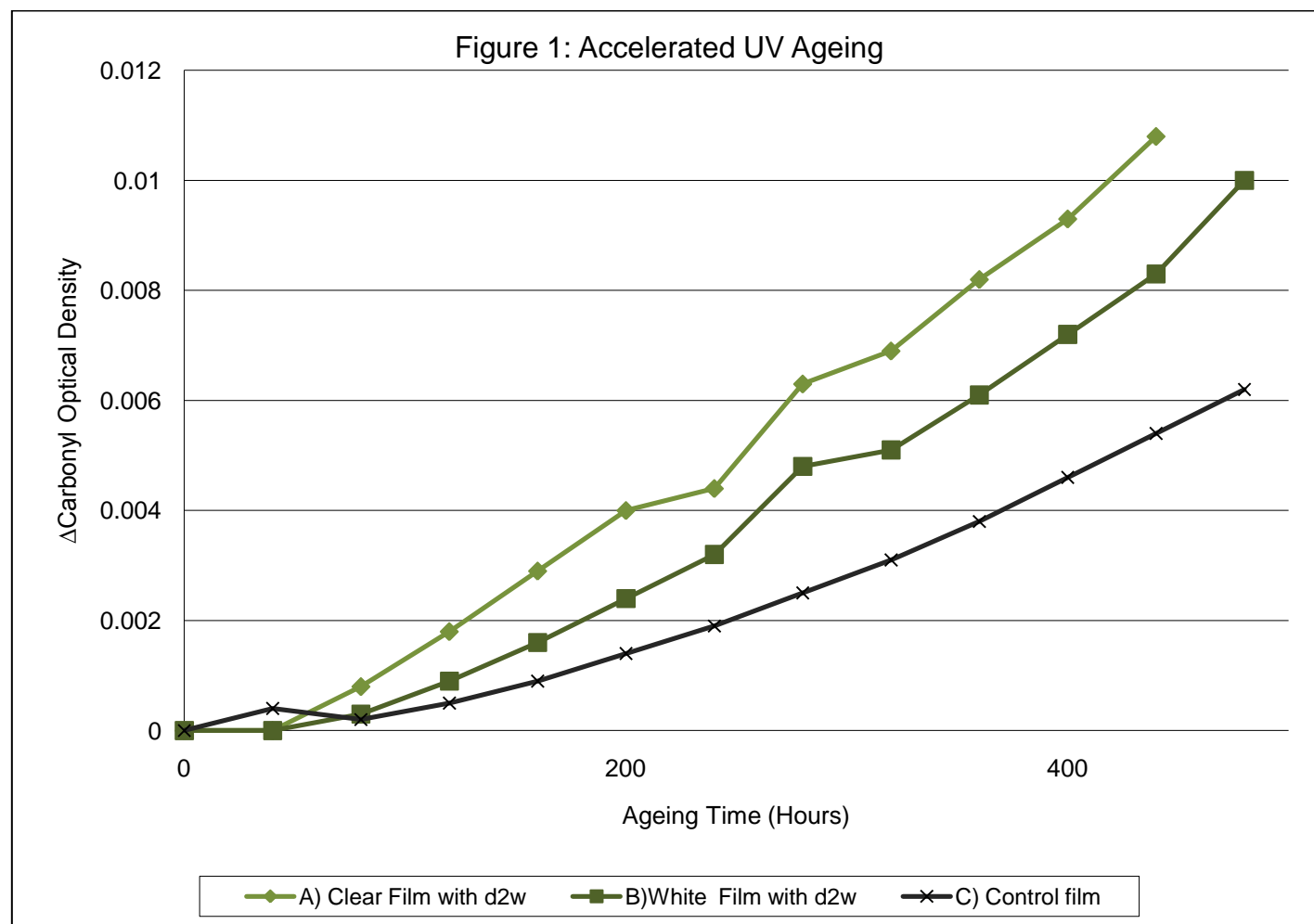
The carbonyl optical density ($\Delta 1713\text{cm}^{-1}$) of the samples was determined by FT-IR spectroscopy in transmission mode using a Thermo Electron Nicolett FTIR instrument.

The optical density is defined by the magnitude of the carbonyl peak at 1713cm^{-1} divided by the sample thickness. Four optical density measurements were taken at each time point and an average determined.

6.0 RESULTS - Accelerated UV Ageing- Bandol Wheel

Table 1: Carbonyl optical density measurement during accelerated UV ageing- Bandol Wheel

| Sample | Δ Carbonyl Optical Density | | | | | | | | | | | | |
|-------------------------------------|-----------------------------------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | 0 Hrs | 40 Hrs | 80 Hrs | 120 Hrs | 160 Hrs | 200 Hrs | 240 Hrs | 280 Hrs | 320 Hrs | 360 Hrs | 400 Hrs | 440 Hrs | 480 Hrs |
| A) Clear Film with d ₂ w | 0.0000 | 0.0000 | 0.0008 | 0.0018 | 0.0029 | 0.0040 | 0.0044 | 0.0063 | 0.0069 | 0.0082 | 0.0093 | 0.0108 | - |
| B) White Film with d ₂ w | 0.0000 | 0.0000 | 0.0003 | 0.0009 | 0.0016 | 0.0024 | 0.0032 | 0.0048 | 0.0051 | 0.0061 | 0.0072 | 0.0083 | 0.0100 |
| C) Control film | 0.0000 | 0.0004 | 0.0002 | 0.0005 | 0.0009 | 0.0014 | 0.0019 | 0.0025 | 0.0031 | 0.0038 | 0.0046 | 0.0054 | 0.0062 |



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Technical Manager

"The information presented in this report is based on the material actually tested. Performance of finished product made with d₂w(R) additive depends on the conditions under which and length of time for which the additive is stored and on the method of manufacture of the finished product and the heat, light, stress and other conditions to which the finished product is exposed. Nothing in this report constitutes or implies a licence to use Symphony's intellectual property".

Controlled-life plastic technology

d₂w is the only oxo-biodegradable (controlled-life) plastic additive to be awarded an internationally recognised Eco-Label.



Controlled-Life plastic technology



A masterbatch which turns ordinary plastic at the end of its useful life, in the presence of oxygen, into a material with a different molecular structure. At the end of that process, it is no longer a plastic and has become a material which will biodegrade in the open environment in the same way as a leaf.



Stages of oxo-biodegradation with d₂w technology:

1. d₂w masterbatch is added at the manufacturing stage.
2. Film containing d₂w is extruded at the factory and is made into bags or packaging.
3. The product behaves like a conventional product during its intended service life.
4. After its service life, the bag or packaging may end up in the open environment.
5. The d₂w then takes effect and the product begins to degrade in the presence of oxygen.
6. The product eventually biodegrades to nothing more than carbon dioxide, water and biomass.

Added Value with d₂w

- Requires only 1% inclusion rate.
- Works with virgin and recycled plastic.
- Works with PE, PP and PS.
- No change to the manufacturing process.
- Does not lose any of its original properties during its useful life.
- Our customers receive full support from Symphony's Technical and Marketing teams.

Standards – The following standards are used for testing products containing d₂w

- British Standard 8472
- American ASTM D6954
- United Arab Emirates Standard 5009:2009
- French Accord T51-808



**Protecting the environment
with controlled-life plastic.**



Disclaimer: The information provided is general information. For specific applications, please consult our Technical Department. Supplies of d₂w are conditional upon regulatory approval for the purpose(s) concerned in the country or countries concerned.

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