BD Report

Abiotic degradation characteristics as per Tier 1 of ASTM D6954-24

Report issue date: 4th November 2025

Report Issue No.: 001

Sample details: LDPE film containing Reverte™ BD 94718

Received from: Lamaplast S.A.S via Urigo S.A.S

Project Reference No.: BD 2479

Sample(s) received: 18/08/2025

Sample description:

Sample Number	Material Type	Sample Form	Base Colour	Print	Reverte™ Grade	Reverte™ Batch No.	Addition Level (wt%)
15245	*LDPE*	*Film*	*Translucent*	*No*	*BD94718*	*34947*	*1%*

	Prepared by	Authorised by
Signature		
Name	Julie Simmons	Dr Gary Ogden FIMMM CSci
Position	Polymer Technologist	Technical Manager
Date	4th November 2025	4th November 2025

Overview:

The testing detailed in this report was performed wholly at Wells Performance Materials Ltd. (Wells PM).

This report is applicable to the unique sample supplied to Wells PM by Lamaplast S.A.S via our local distributor Urigo S.A.S. It should be noted that the report does not guarantee that subsequent production batches manufactured by Lamaplast S.A.S will contain Reverte™ biodegradable masterbatch manufactured by Wells PM at the correct dosage level.

Unless otherwise stated, the testing, analysis and reporting of the results of the evaluation reported here were performed in accordance with the referenced applicable methods (internal, national or international.)

Reference standards:

ASTM D6954-24: Standard guide for exposing and testing plastics that degrade in the environment by a combination of oxidation and biodegradation.
ASTM 5208-01: Standard Practice for Fluorescent Ultraviolet (UV) Exposure of Photodegradable Plastics.
ASTM 5576-00: Standard Practice for Determination of Structural Features in Polyolefins and Polyolefin Copolymers by Infrared Spectrophotometry (FT-IR).

Work Instructions used in this evaluation:
QWI82 Production of BD graph & test report
QWI85 Accepting a BD sample
QWI86 BD Sample preparation
QWI91 Operating FT-IR for analysis of BD samples
QWI92 Printing BD sample FT-IR scans
QWI93 Conducting UV degradation testing

1. Background

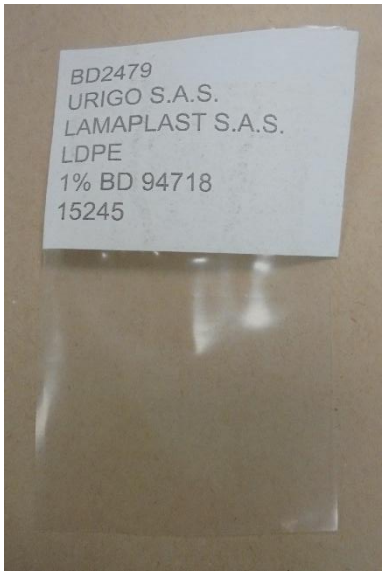
Lamaplast S.A.S is interested in evaluating Wells PM Reverte™ biodegradable additive masterbatch for use in PE film.

Reverte™ biodegradable additive masterbatch BD 94718 has been recommended for this application, this grade is polyethylene based and is generally suitable for inclusion in a broad range of polyethylenes including high density polyethylene (HDPE), low density polyethylene (LDPE) and linear low density polyethylene (LLDPE). It has been designed for use in applications where clarity of film is not of primary importance, such as retail carrier bags.

Reverte™ BD94718 has been developed for a 1% addition to give thin section PE films maintained at 20°C a controlled in-house shelf life of approximately 18 months, a further dwell time, normally around 2 to 6 months after photoinitiation and then a rapid transformation of material properties to low molecular weight materials which are available for biodegradation, normally after around 8 - 18 months. However, thicker section products, some stabiliser packages and specific polymer blends and pigmentation can significantly extend this time period and thinner sections, mineral fillers etc. can shorten it.

Lamaplast S.A.S supplied one sample for evaluation of its biodegradable properties. The sample was a translucent film described as “Caliber 2 – Market Packing”. It was detailed as being produced from LDPE and submitted as containing 1% BD 94718. A section was cut out of the sample and labelled with a description/internal testing number for identification. The sample was subjected to testing at Wells PM laboratory in Stone, Staffordshire, UK.

2. Samples as received / before testing



3. Method

The high molecular weight of commercial grades of polymers renders them fundamentally hydrophobic and, therefore, very resistant to direct microbial attack.

Reverte™ biodegradable additive masterbatches catalyse the abiotic degradation of the polymer chains into low molecular weight waxy materials which are then available for biodegradation in the open environment. The initial chain scission (abiotic degradation) of the polymer causes a serial reduction in polymer molecular weight which ultimately results in material transformation into none polymeric (none plastic) species and availability for biodigestion.

This degradation can be tracked by the measurement of critical physical properties, using test methods such as ASTM D3826 to measure properties such as elongation, but this method is somewhat flawed because as the abiotic degradation gets underway the test sample becomes too friable for physical testing.

Abiotic degradation causes the formation of a carbonyl group at the point of every chain scission, measurement of the onset and level of this carbonyl group development in the test product is a more accurate measure of its structural transformation.

The sample was aged using a modified ASTM D 5208-01 (Cycle C) test method. The ageing cabinet utilised contained UV lamps to simulate gentle outdoor sunlight. The temperature of the cabinet was maintained at 50°C according to the test method. Results from Wells PM standard PE film without any Reverte™ was presented alongside the test specimen as a comparative control.

It should be noted that the level of UV exposure generated in the ageing cabinet is very low and should not be compared with the levels generated, for example, in QUV ageing experiments.

In effect, the UV exposure level is around 26kLy per year in the cabinet, to put this in perspective, to simulate a full year's outdoor exposure in the UK the samples would have to be in the cabinet for around 3 to 4 years, to match a year in mainland Europe they would have to be in the cabinet for around 4 to 5 years and a year in Florida USA would be simulated by 9 to 10 years in the cabinet.

The test specimen was removed after fixed time periods and the carbonyl index determined by Infra-red analysis, using a modified ASTM D 5576-00 test method. In addition, the sample was empirically assessed for transformation from polymeric composition to low molecular weight waxy materials. The carbonyl index at the point at which the test piece was considered fully transformed (EAB <5%) was noted and presented as 100% transformation. The remaining carbonyl indices were calculated as a percentage of this and presented as "Degree of Transformation".

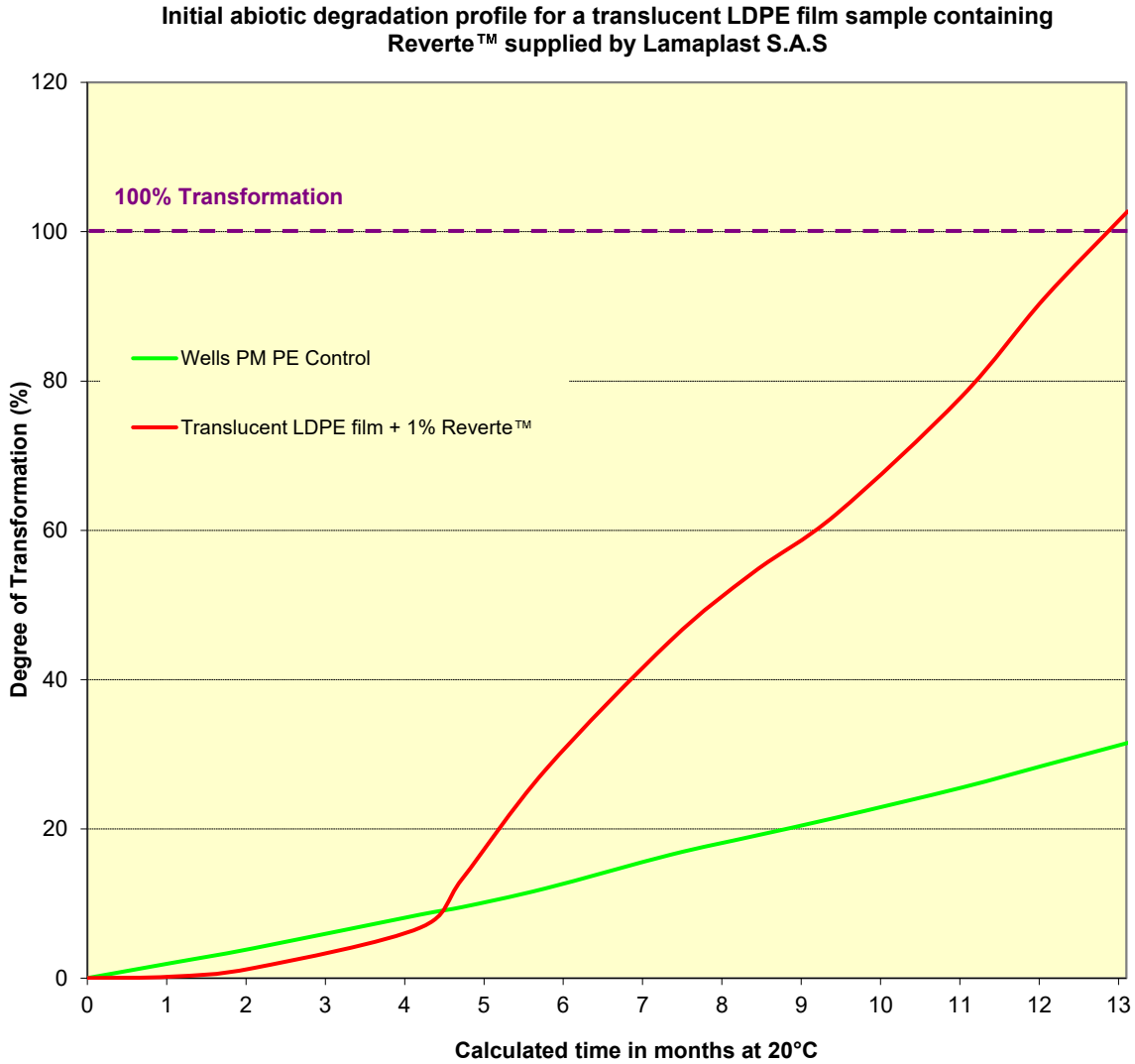
Finally, Arrhenius principles were applied to the results obtained at 50°C, transposing them into the real-time results that would be expected at 20°C.

4. Results

4.1 Degree of Transformation

	Degree of Transformation (%)											
Accelerated Ageing Time (hours at 50°C)	**0**	**48**	**96**	**192**	**216**	**264**	**336**	**384**	**432**	**504**	**552**	**600**
Calculated Time (months at 20°C)	**0.0**	**1.0**	**2.1**	**4.2**	**4.7**	**5.8**	**7.3**	**8.4**	**9.4**	**11.0**	**12.1**	**13.1**
Wells PM PE Control	0.0	2.0	4.0	8.5	9.5	12.0	16.5	19.0	21.5	25.5	28.5	31.5
Translucent LDPE film + 1% Reverte™	0.0	0.2	1.4	6.8	13.2	27.8	45.1	54.3	62.2	77.8	91.1	102.7

4.2 Graph of results



5. Discussion of Results

It is always difficult to precisely quantify results obtained in terms of real-time abiotic degradation due to the range of natural conditions found in the environment. However, the Arrhenius principles applied to the accelerated ageing results in this report enable a calculation to be performed for expected abiotic degradation in a real-world environment at a constant temperature of 20°C in sunlight.

The Wells PM PE control film sample demonstrated fairly typical behaviour, only reaching a level of transformation of c.31.5% after the 600 hour accelerated ageing period (c.13.1 months at 20°C).

In marked contrast the translucent LDPE film sample containing Reverte™ BD 94718 demonstrated a greatly enhanced abiotic degradation profile. The sample showed a distinct "dwell time" of ~206 accelerated ageing hours (c.4.5 months at 20°C) during which time no induced abiotic degradation was evident compared to the control. This was followed by a controlled transformation in physical and molecular properties with the sample reaching 100% transformation after ~590 accelerated ageing hours (c.12.9 months at 20°C).

It can be seen that the translucent LDPE film sample containing Reverte™ displayed the characteristic "dwell time" expected to be exhibited by Reverte™ containing products. This dwell time gives an enhanced window of confidence in the use of biodegradable additive technology as no induced abiotic degradation is evident for the first time period of the product's calculated working lifetime following its environmental exposure.

These are idealised real-time projections based on accurate accelerated laboratory ageing and, as previously stated, natural climatic conditions of sunlight, soil temperature etc do vary. These extrapolated results have, therefore, been prepared in good faith, but any potential user may wish to carry out independent empirical observations to ensure that the product is fit for purpose.

6. Conclusions

1. The addition of the correct level of Reverte™ BD 94718 biodegradable additive masterbatch to the translucent LDPE film sample submitted by Lamaplast S.A.S has been shown to be effective in introducing an abiotic degradation characteristic, giving a readily distinguishable dwell time after laboratory environmental exposure followed by a controlled transformation to a fully biodegradable material.
2. As illustrated in the report graph the product will remain stable and fit for purpose during storage and non-exposure to heat & sunlight. Whilst at the end of its useful life and exposure to the environment, provided that there is some initial sunlight and an average temperature of 20ºC it will subsequently transform into a biodegradable waxy non-plastic material.
3. When tested to the conditions detailed in the report, the sample provided had an estimated dwell time following initial exposure to UV light of ~206 accelerated ageing hours (c.4.5 months at 20ºC) and an estimated shelf life before its transformation into a non-plastic material of ~590 accelerated ageing hours (c.12.9 months at 20ºC).
4. Finally, it should be noted that even when a control film may have degraded through normal UV/oxidative attack, this doesn't mean that the chain scission will continue in a uniform and controlled manner until the chains are short enough for microbial digestion.

The marketing claims which can be made about biodegradable materials may vary from country to country and in some regions may be legislated through trade and consumer bodies. In some regions 'green claims codes' may restrict how the benefits of the Reverte™ biodegradable technology can be described or depicted in marketing claims. It is the responsibility of the end user to satisfy themselves that they are marketing the product in line with the market destination for which the product is intended. Wells Performance Materials cannot be held responsible for the incorrect marketing of end products by users of the technology and we recommend that all marketing statements are checked by lawyers familiar with the local legislation.

This information is correct to the best of our knowledge, but we would recommend that users make their own assessment to confirm that the material meets their requirements. We accept no liability for any damage, loss or injury resulting from the use of this information. Freedom from patent rights must not be assumed.

Wells Performance Materials Limited
Emerald Way, Stone Business Park, Stone,
Staffordshire. ST15 0SR. UK
Tel : +44 (0)1785 817421
www.techcnial@wellspm.com
www.revertebio.com www.wellspm.com

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