



TECHNICAL INFORMATION SHEET 15

Oxo-biodegradable characteristics of Reverte masterbatches for use in packaging film applications.

1. Product Grade and addition level

The material that has been used in the production of PE film intended for toilet tissue packaging is Reverte BD 92845.

The recommended addition rate is 1% by weight.

2. Food Contact Suitability

Polyethylene film containing Reverte BD 92845 has been independently tested and certified as suitable for direct food contact applications.

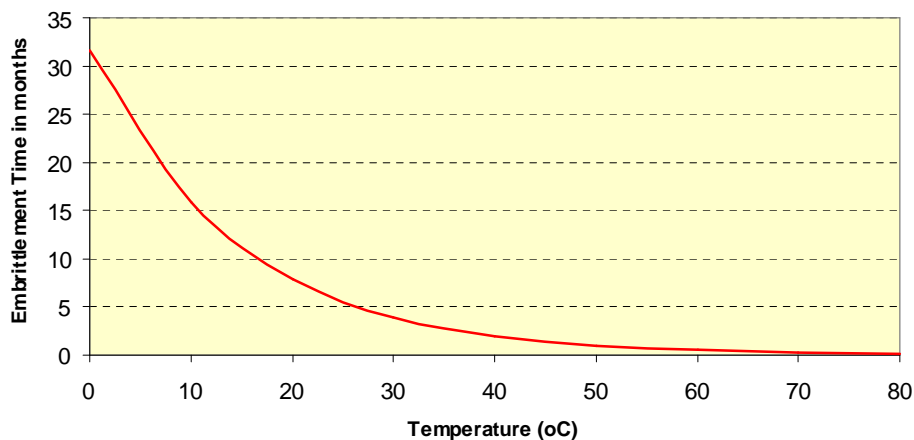
Certification to the European 2002/72/EC specification is attached.

3. Degradation Kinetics of Reverte BD 92845

3.1 Arrhenius Plot of Degradation profile.

The plot below was constructed from data obtained through in-house testing at Wells Plastics.

Arrhenius Plot of Degradation Characteristics of Reverte BD 92845 in PE film



It can be seen that ambient temperature plays an important role in determining the precise degradation profile of the oxo-biodegradable film.



3.2 Degradation Profile.

3.2.1 Technical Explanation of Degradation Profile Test Method.

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

A reduction of the polymer chain length from its initial value of around 250,000 to a value between 4,000 and 10,000 increases its intrinsic microbial accessibility and enables subsequent biodegradation.

Reverte products initially catalyse the oxo-degradation of the polymer chains and then promote the growth of microbial colonies to expedite the second biodegradation stage.

The initial chain scission (degradation) of the polymer chain causes a serial reduction in polymer molecular weight which ultimately results in acute embrittlement, microfragmentation and ultimately biodegradation.

Oxo-degradation causes the formation of a carbonyl group at the point of every scission. Measurement of the onset and level of carbonyl group development in the test sample is a direct measure of its induced degradation by the metal ion pro-degradant.

Polyethylene is generally reduced to an embrittled state when the carbonyl index is greater than approximately 0.1 to 0.3 depending on the grade of PE under consideration.

3.2.2 Test Method.

Samples were aged in a UV ageing cabinet with UVA and UVB lamps to simulate outdoor sunlight. The temperature of the cabinet was maintained at 50°C.

Samples were removed after fixed time periods and the carbonyl index determined by Infra-red analysis. In addition the films were empirically assessed for friability and state of embrittlement.

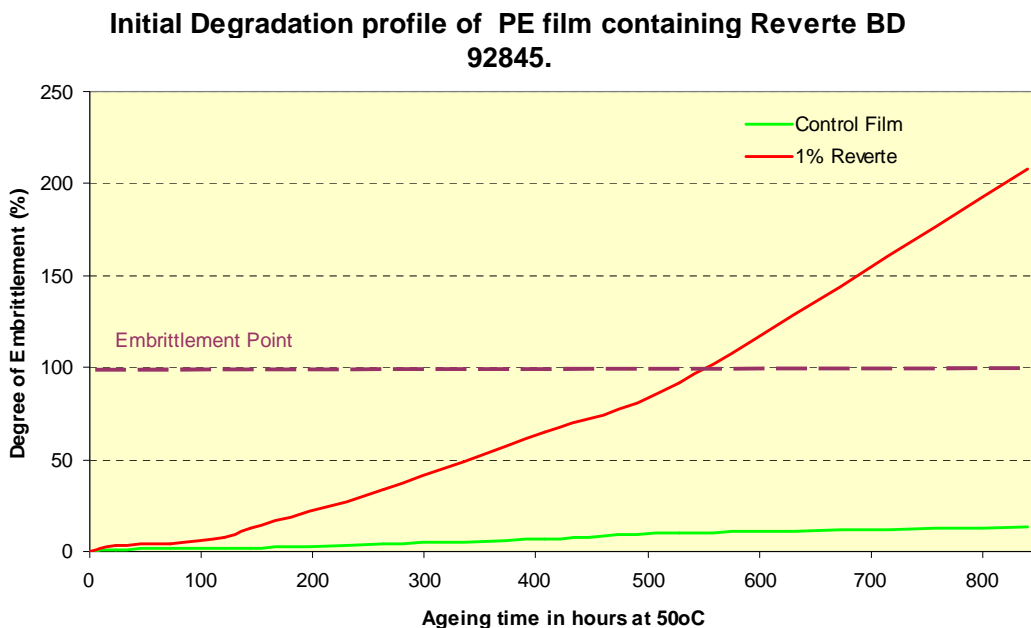
The carbonyl index at the point at which the film was embrittled was noted and presented as 100% embrittlement. The remaining Carbonyl indices were calculated as a percentage of this and presented as "Degree of Embrittlement".



3.2.2 Test Method (Continued).

A plot of the results obtained from the toilet tissue packaging under consideration may be seen below :

3.2.3 Plot of Reverte BD 92845 Degradation profile



3.2.4 Discussion of results

In contrast to the non-degradation of the control, the film containing BD 92845 has demonstrated a highly enhanced rate of decomposition, with its measured degree of embrittlement rising to more than 200% during the test.

This indicates a high level of degradation and is associated with acute embrittlement and film breakdown.

In this case the film was found to be severely embrittled and microfragmented at the slightest touch.

3.3 Interpretation of results

It is always difficult to precisely quantify results obtained in terms of real-time degradation due to the vagaries of natural conditions. However, applying Arrhenius principles to these accelerated ageing results would suggest that once the degradation procedure was underway then ageing for 12 hour days at a constant temperature of 20°C in sunlight would result in the film degrading to embrittlement in around 12 months.



3.3 Interpretation of results (Continued).

These results indicate that the product containing Reverte additive will meet the toilet tissue manufacturer's requirement of disappearing completely within a four year period once it enters the landfill waste stream.

4. Independent Verification.

Plastic film containing Reverte additive has been tested by RAPRA (a UK based independent test-house) and has been found to exhibit appropriate degradation characteristics.

Relevant parts of their confidential Test Report no 46987 are appended.

5. Statement

Wells Plastics Limited has been manufacturing and supplying Reverte oxo-biodegradable masterbatches for several years and their efficacy has been shown on many occasions.

The test data included in this Information Sheet demonstrate this efficacy and enables us to state that the specific PE film tested for the proposed toilet tissue application should meet the required pack specification of a maximum 4 year period to total disintegration and disappearance subject only to the natural and uncontrollable variables of weather and temperature as indicated by the Arrhenius plots contained within the report.


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