

KRITILEN[®] FTD 523

Oxo - Degradable Masterbatch

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Technical information

KRITILEN[®] FTD523 is an oxo-degradable masterbatch. It contains selected pro-degradants, which impart photo-degradable and thermo-degradable properties to polyolefins. These additives oxidize the polymer and reduce its chain length, by introducing oxygen into its structure. As a result, the polymer molecular weight is reduced, causing the fragmentation of the end plastic product. This process is triggered by UV irradiation and heat exposure.

By reducing the chain length of the polymer, the material loses its physical strength and elongation properties and becomes brittle.

Depending on the end product disposal conditions, the polymer molecular weight can be reduced to such an extent that the plastic product is consumed by micro-organisms and finally is converted to biomass, water and carbon dioxide.

KRITILEN[®] FTD523 is mainly proposed for use in polyethylene films at let-down ratios ranging from 1% to 2%.

Experimental Data

The KRITILEN[®] FTD523 performance is tested and evaluated in a laboratory scale. Two HDPE films (with thickness of 20mic) were produced, one without any additive and another with 1% Kritilen[®] FTD523. Both films were exposed to thermal degradation at 40oC, 60oC and 80oC and also to UV radiation. The degree of degradation was assessed by measuring the mechanical properties of both films before and after the exposure to heat and UV radiation.

Comparison between HDPE films (20mic) with and without KRITILEN® FTD523

A) Thermal degradation

The thermal degradation was evaluated according to BS8472:2011.

The mechanical properties were measured according to EN-ISO 527-3.

The mechanical properties before and after the heat exposure are shown in the table that follows:

Sample	Mechanical properties		Before exposure	15 weeks at 40 °C	15 weeks at 60 °C	15 weeks at 80 °C
HDPE film	Strength (MPa)	Longitudinal	36	37.2	34.9	17.2
		Transverse	19.2	18.8	17.8	20.2
	Elongation at break (%)	Longitudinal	380	370	400	60
		Transverse	660	670	670	25
HDPE film + 1% FTD523	Strength (MPa)	Longitudinal	42.8	14	At these conditions, the samples were fully fragmented.	
		Transverse	15.9	11.7		
	Elongation at break (%)	Longitudinal	410	4.7		
		Transverse	700	1.1		

According to the above table, the degradation of HDPE film with 1% KRITILEN® FTD523 has occurred at:

- 40 °C: After 97 days of ageing
- 60 °C: After 10 days of ageing
- 80 °C: After <10 days of ageing

B) UV degradation

The two films were evaluated after exposure to UV radiation according to ISO 4892-3 Method A, Cycle 1 (UVA 340nm).

Cycle 1 includes the following steps:

- 8hr dry environment, Irradiance: 0.76W/m², BST: 60 ± 3 °C
- 4hr condensation, UV lamps off, BST: 50 ± 3 °C

The mechanical properties before and after the UV radiation exposure are shown in the following table:

Sample	Tensile properties		Before exposure	168 hours in QUV	
HDPE film	Strength (MPa)	Longitudinal	36	17.8	
		Transverse	19.2	18.7	
	Elongation at break (%)	Longitudinal	380	61	
		Transverse	660	5.2	
HDPE film + 1% FTD523	Strength (MPa)	Longitudinal	42.8	At these conditions, the samples were fully fragmented.	
		Transverse	15.9		
	Elongation at break (%)	Longitudinal	410		
		Transverse	700		

According to the above table, the HDPE film with 1% Kritilen® FTD523 has been degraded after 168 hours of UV exposure.

All above measurements have been conducted by an external laboratory, specialized in the assessment of oxo-degradable masterbatches. The detailed evaluation report is available upon request.

A) Conclusions

The above measurements show that HDPE film samples with 1% KRITILEN® FTD523 reach the brittle point for degradable polyethylene, as stated in ASTM D 3826 “Standard Practice for Determining Degradation End Point in Degradable Polyethylene and Polypropylene Using a Tensile Test”, which is achieved when the elongation after exposure is $\leq 5\%$.

Based on the above results, KRITILEN® FTD523 is characterized as an oxo-degradable masterbatch.

End Uses - Conditions

KRITILEN® FTD523 is mainly proposed for use in HDPE, LLDPE or LDPE films of various thicknesses. It can also be used in injection or blow molded polyethylene and polypropylene parts.

The degree and speed of degradation will depend on the antioxidant package contained in the basic polymer of the end application, the product thickness, the ambient temperature and humidity, and the exposure duration of the end product under UV. The users should verify the suitability of Kritilen® FTD523 and determine the appropriate let-down ratio under the actual conditions of their applications.

End processors, using KRITILEN® FTD523, can print the following logotype on the end product:



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