Trioxo-d® Degradable/Biodegradable Plastics Specifications

GreenKleenCertified™ BioSafe Bags

1.1 | INTENT

1. This section covers the qualifications of the products. It covers the degradation mechanisms, degradation testing methods, product properties, performance and uses of the products.

2. The following sections include relevant information for all plastic products (PE/ PP/ PS) made with the Trioxo-d® formula.

    - Shopping Bags, Fresh Produce Bags, Bread Bags, Grocery Bags
    - Plastic Garbage Can Liners.
    - Doggie Clean-Up Bags
    - Cling, Stretch and Shrink Films
    - Packaging Bags
    - Plastic Food Containers
    - Food Trays
    - Cutlery and Tableware

1.2 | DEFINITION OF Trioxo-d® OXO-DEGRADABLE/BIODEGRADABLE PLASTICS

Oxo-Biodegradable Plastics use the same resins as conventional plastics but they contain an additive that changes the molecular structure of the plastic. GreenKleenCertified™ Biosafe Bags are an example of an Oxo-Biodegradable Plastic Product. What sets Biosafe Bags apart from others is that they contain a proprietary exclusive, Trioxo-d®, that greatly accelerates the break-down process of the plastic.

Once active degradation begins the plastic becomes brittle (experiencing a loss in tensile strength and elasticity), breaks up into small pieces and then during the natural digestion process, it turns itself into a food source for microbes and fungi. The plastic pieces are converted into energy, carbon dioxide, water and biomass.

1.3 | DESIGN REQUIREMENTS

1. All Trioxo-d® degradable/biodegradable plastics meet or exceed the performance standard of non-degradable plastics.

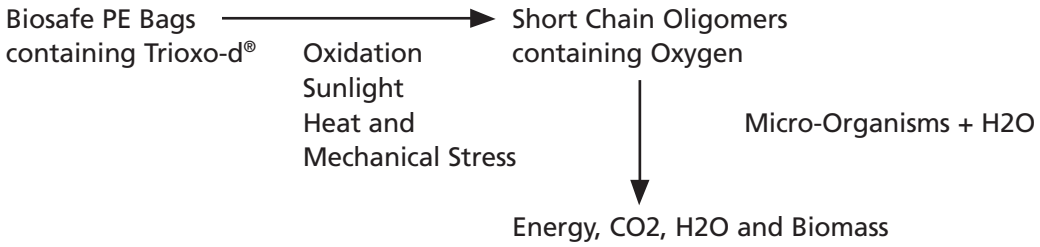
2. All Trioxo-d® Degradable/Biodegradable Plastics meet international standards for degradable plastic measures. A standard guide that recognizes Oxo-degradability as a viable process does exist (ASTM6954-2004 – provides methods but no pass/fail criteria). Furthermore, a standard for the behavior of plastics in landfills is in development at ASTM.

3. Biosafe Bags integrated with Trioxo-d® formula contain a minimum of 10-25% recycled material.

1.4 | DEGRADATION MECHANISMS FOR PLASTICS INCORPORATED WITH TRIOXO-D®

1. The Trioxo-d® additive is blended into the polyethylene resins during production to give the plastic special degradation properties without impacting productivity or product integrity. After the plastic product is used and then disposed of in landfills, or inadvertently as litter, these Trioxo-d® plastic products undergo oxidative degradation much more rapidly than ordinary plastics. Mechanisms that trigger this process are sunlight (UV), heat and mechanical stress. In the presence of moisture, micro-organisms, oxygen and soil the PE products incorporated with the Trioxo-d® additive will ultimately biodegrade as per ASTM D6954-04.

2. Science of Degradation/Biodegradation



3. Guidelines for Degradation of Trioxo-d® plastics information

-Shelf Life:	12-18 months
-Total Degradation	12-24 months
-Total Biodegradable	12-24 months

The above data is only for reference and is based on our laboratory test results in regard to the guidelines of ASTM testing methods for plastic degradation. The final product degradation/biodegradation controlled time frame provided above may vary due to different environmental conditions.

1.5 | QUALITY ASSURANCE FOR TOTAL DEGRADATION AND BIODEGRADABLE

All Trioxo-d® plastic products are tested by the following ASTM testing methods for plastic degradation.

1. ASTM 5576-00 - FTIR Test (Photo - Degradation)

The FTIR (Fourier Transform Infrared Absorption Spectrometer) test determines the chemical changes occurring in the polymetric structure of the film after pre-aging process under UV light or heat conditions. The chemical change of interest is the detection of ketonic group in the Carbonyl Region. When the degradation process occurs for polyethylene material, the polymeric chain will be oxidized generating end fragments of carbonyl group (>C=O), especially ketones. The >C=O stretching frequency (saturated open-chain ketones) can be detected via infrared absorption spectra.

2. ASTM D5510-01 Oven Heat Aging 70 deg C

The Heat-Aging test is intended to define the exposure conditions of the plastic at various temperatures when exposed solely to hot air for intended periods of time. This method replicates the conditions in end-disposal environment such as landfills and composting facilities.

3. ASTM D1238-04 Melt Index

The Melt Index is determined by using an Extrusion Plastometer. The melt index is an indirect relationship to the molecular weight of the polymeric material tested. The higher the Melt Index (Melt Flow rate, g/10min), the lower the molecular weight of the sample tested. Test Parameters are set according to ASTM D1238-01e1 Test Parameters on the condition used were 190 deg C /2.16kg

4. ASTM D5208-01 QUV (Accelerated Weathering Test)

QUV is the equipment that can reproduce weather conditions in an accelerated manor, offering results in few days or weeks similar to the damage that occurs outdoor over months or years. The sample is exposed to the UV radiation, heat and moisture replicating the effect of sunlight, rain and dew in the day/night cycles. The machine can be set up in cycles that can be programmed (i.e. UV irradiance, temperature, condensation and the timing for each cycle.) These test parameters are set according to ASTM D5208-01. Samples are exposed to different time periods and the physical, chemical and mechanical characteristics of the polymeric material (PE) are tested before and after QUV exposure.

5. ASTM D882-02 and ASTM D3826-98 Tensile Elongation Test

The test characterizes the mechanical performance of the film. The specimen is stretched until it breaks and that length is measured. Test parameters are set according to ASTM D882-02 (i.e Specimen o.5" wide/speed 2" per min. and 4" in length.) The elongation at break varies inversely with QUV exposure time; the integrity of the polymer structure (tensile/elongation) decreases when degradation process occurred in the QUV.

REMARKS

1. The photo-degradation test is used to determine the degradability rate of the finished product if accidentally exposed to UV light.

2. The thermo-degradation time is used to determine the shelf life of the finished product and its degradability rate after end disposal (landfills).

1.6 | PRODUCT PERFORMANCE

Biosafe bags integrated with the Trioxo-d® additive meet and exceed the performance of other non-degradable PE bags currently in use.

Performance tests	Results
Tensile Strength	Exceeds
Elongation	Exceeds
Impact Resistance	Exceeds
Clarity	Exceeds
Printability	Exceeds
Permeability	Exceeds
Seal ability	Exceeds
Recyclable	Meets
Degradability	Meets

1.7 | ENVIRONMENTAL BENEFITS

- Quality assurance: Canadian technology. Quality bags made in China to GreenKleenCertified™ stringent specifications
- 100% degradable/biodegradable plastic bags for all landfill waste
- Proven degradable products in landfill environment, ultimately taking up less landfill space
- Controlled degradation time, 12-24 months reduces Green House Gases (Methane Gas) in landfill
- No adverse toxicological effects or by-products
- A degradable plastic product (degradation end-point as per ASTM D3826)
- A biodegradable plastic product (biodegradability measured as per ASTM D5988)
- Tinted green and clear bags structure helps to implement waste recycling program effortlessly, improve workplace safety and security issues
- Environmentally responsible, reduces corporate branded litter to improve corporate public relations
- Compliance to ASTM D6954-04

PART 2

2.1 | MANUFACTURER

Ecosaf Plastic Ltd

2.2 | PRODUCT NAME

GreenKleenCertified™ Biosafe Plastic Bags for:

A/ Waste Management for Commercial and Domestic Applications
B/ Doggie Clean-Up Bags
C/ Shopping Carrying Bags

2.3 | RAW MATERIALS

- Polyethylene Resins
- Recycled Plastic Resins
- Exclusive Proprietary Trioxo-d® Additive

2.4 | PRODUCT MARKINGS

1. All clear green or opaque green plastic bags with multiple markings of "Trioxo-d®" meet this specification.

2. Products not marked with "Trioxo-d®" may not meet this specification and may not be degradable/biodegradable.

2.5 | REFERENCES

Oxo-biodegradable Plastics Institute.
www.oxobio.org

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