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**مواصفات وخصائص أئياس البلاستيك وغيرها من مخلفات البلاستيك القابل
للتحلل**

**Standard & Specification for Oxo-biodegradation of Plastic
bags and other disposable Plastic objects**

دولة الإمارات العربية المتحدة
UNITED ARAB EMIRATES

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مواصفات وخصائص أكياس البلاستيك وغيرها من مخلفات البلاستيك القابل للتحلل
Standard & Specification for Oxo-biodegradation of Plastic
bags and other disposable Plastic objects

Standards of United Arab Emirates

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Foreword

Emirates Authority for Standardization & Metrology (ESMA) is the national standardization body (NSB) and is charged with the responsibility for standardization activities in UAE. One of ESMA's main functions is to issue National Standards, and recommend them to the UAE Cabinet for adoption as Technical Regulations.

ESMA-WG 1, a committee of experts set up by ESMA "For standardization of degradable plastic" prepared this draft, "***Standard & Specification for Oxo-biodegradation of Plastic bags and other disposable Plastic objects***".

The Steering committee for degradable plastics recommended the adoption of this draft as UAE. Technical Regulation (Mandatory Standard).

Introduction

1. Oxo-biodegradable carbon-chain polymers degrade by an oxidation pathway. This is normally initiated abiotically and the chemical species that are formed have been shown to subsequently biodegrade rapidly, with the formation of cell biomass and carbon dioxide. The biodegradation mechanisms of pure oxo-biodegradable hydrocarbon polymers are very similar to those involved in the biodegradation of naturally occurring material, in particular, lignocellulose in the form of straw, twigs, sawdust etc.

The Chemical formulation inside oxo-biodegradable plastic breaks the molecular chains and converts it into a material which is no longer a plastic but can be bio-assimilated by micro-organisms found in the environment. It therefore simulates the way nature disposes of wastes such as leaves and straw, but much more quickly.

Biodegradation in the environment is not the same thing as composting. Composting is an artificial process operated according to a much shorter timescale than the processes of nature. Standards (such as ASTM D6400 and EN13432) designed for compostable plastic are not therefore appropriate (except for their eco-toxicity tests) for plastic which is designed to biodegrade if it gets into the environment

2. The rate of peroxidation (breakdown via atmospheric molecular oxygen) in plastics is accelerated by transition metal compounds, notably iron, cobalt and manganese, and retarded by antioxidants. The particular combination of metal ions and antioxidants determines the rate of the abiotic phase that leads to the formation of low molar-mass biodegradable chemical species.

3. Although the rate of ultimate bioconversion of polyolefin to carbon dioxide, water and biomass is not critical for most applications, the pass criteria for this method are no less than that for the bioconversion of nature's lignocellulosic wastes, typical of these is straw, which requires about 10 years to mineralize completely.

4. The environment in the United Arab Emirates, as in the rest of the GCC, presents certain characteristics particular to the region as for example, an abundance of sunlight (a strong UV source) and high ambient temperatures – especially during the summer months. The general sandy topography is not an intensely microbial environment, leaving little or no room for a purely biotic degradation and soil assimilation processes. This Standard therefore focuses on the oxo-degradative effects through Thermal and UV degradation under atmospheric conditions.

Standard & Specification for Oxo-biodegradation of Plastic bags and other disposable Plastic objects

1. Scope

1.1 This Standard covers the Regulatory Criteria applicable to all oxo-biodegradable bags, packaging and disposable articles made from plastic polymers derived from fossil-fuels.

1.2 The items covered by this standard are essentially, but not limited to, flexible shopping bags and semi-rigid plastic packaging for food, magazines, consumer-durables, garbage bags, bin-liners for household use, shrink wrap, pallet wrap, cling film etc and other articles normally used over short periods and subsequently discarded.

1.3 This standard lays down the criteria to be met to prove chemical modification by oxidative processes under U.A.E. climatic conditions, into oxidized particles that may subsequently be converted to carbon dioxide, water and biomass, and to ensure that the residue is below regulated levels of metal concentration.

Note: There is no ISO standard equivalent to this Standard.

2. Referenced standards

All relevant Standards, Guidelines, Tests, and Methodology as outlined in the latest editions of the following Standards are acceptable as normative documents for the purpose of compliance with this Standard:

2.1 UAE.S ISO 14851 “Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium — Method by measuring the oxygen demand in a closed respirometer”

2.2 UAE.S ISO 14852 “Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium — Method by analysis of evolved carbon dioxide”

2.3 UAE.S ISO 14855-1” Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide — Part 1: General method”

2.4 UAE.S ISO 14855-2 “Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide — Part 2: Gravimetric measurement of carbon dioxide evolved in a laboratory-scale test”

2.5 UAE.ASTM D 6954 “Standard Guide for Exposing and Testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation”

2.6 UAE.S ASTM D 883 “Standard Terminology Relating to Plastics”

2.7 BS 8472 : Method for determining Biodegradability and Non-eco toxicity of Oxo-Biodegradable Plastics.

2.8 SPs Certification rules for classification of polymeric waste – SPCR 141 (Swedish National Testing and Research Institute)

3. Terminology

3.1 This Standard specifically addresses plastic polymers derived from fossil fuels such as Petroleum Crude Oil and associated or unassociated Natural Gases.

3.2 All other general definitions given in Terminology as outlined in UAE.S ASTM D 883 “Standard Terminology Relating to Plastics”

3.3 CEN/TR 15351 “Plastics - Guide for vocabulary in the field of degradable and biodegradable polymers and plastic items” are applicable to this Standard.

4. Significance and Use

4.1 Materials made with oxo-biodegradable plastics are intended to show relatively rapid deterioration (as compared with normal plastics of the same type) of chemical, physical and mechanical properties when exposed to light, heat, and air after ~~filling~~ their intended purpose. The purpose of the addition of pro-degradant additives to plastic polymers derived from fossil fuels is to induce property changes associated with conditions that might be experienced when the material is discarded as litter, including the effects of sunlight, moisture, and heat. The exposure used in this practice is not intended to simulate the deterioration caused by localized weather phenomena such as atmospheric pollution.

4.2 In the U.A.E. environment it is necessary to ensure that the particle size of the degraded plastic object is such that not only are they not visible, to mitigate unsightly litter, but also to ensure that the final residue does not add to soil toxicity. As is known from existing studies, particles of such small sizes are expected to be eventually bio-assimilated rapidly under appropriate environmental conditions.

5. Test Requirements

5.1 All tests need to be carried out strictly under the protocols laid out in any of the normative documents.

5.2 All included components such as polymers, organic additives (plasticizers, impact modifiers, fibers, etc...), inorganic fillers, pigments, stabilizers, pro-oxidants etc shall be declared to ESMA with chemical/trade name and, where possible, the percentage of each component shall also be given. None of the included components constituting $\geq 0.1\%$ may be used if officially classified as environmentally hazardous.

5.3 Abiotic Degradation: An abiotic degradation test shall be performed, to simulate the degradation processes likely to occur in the U.A.E. disposal environment. The extent of degradation shall be evaluated by measuring the loss in mechanical properties, decrease in molecular weight, and determination of gel content.

Requirements shall be:

- Average molecular weight <5,000 Daltons.
- Gel Fraction <5%
- Elongation at break $\leq 5\%$ of the original value.

The abiotic degradation test must proceed so that in 4 weeks the resulting material demonstrates biodegradable residue as stated above.

5.4 The residual material from the abiotic tests shall not create harmful or persistent residues as measured by its maximum metal concentration as follows:

Element	Mg/kg of dry substance	Element	Mg/kg of dry substance
Zn	150	Cr	50
Cu	50	Mo	1
Ni	25	Se	0.75
Cd	0.5	As	5
Pb	50	F	100
Hg	0.5		

5.5 A sample of the residual material from the abiotic degradation test shall be dissolved in an appropriate nonreactive solvent and the gel phase, if any, separated by filtration, dried, and the weight ratio of gel to the total sample established. This is regarded as the nondegradable fraction of the polymer, and should be $\leq 5\%$.

5.6 A portion of the residual material from the abiotic degradation test shall be tested for ultimate aerobic biodegradability under controlled conditions in a laboratory environment by analysis of evolved carbon dioxide.

5.7 60 % of the organic carbon must be converted to carbon dioxide within 6 months. Based on the test results the anticipated storage life and service life shall be reported at 8.2 below.

5.8 It is a requirement that at least three replicates of each material evaluated be exposed to allow for statistical evaluation of results.

6. Certification

6.1 Certificates shall be issued or refused by ESMA, having regard to the test results reported under paragraph 8 below.

6.2 The validity period for an achieved (end) product certificate is five years.

6.3 When a material or a product entirely or partially consists of already approved components (the certificate still being valid and registered with ESMA), parts of the test

scheme may be excluded for these components after consultation with ESMA. However in the case of end-products a report including results of disintegration testing, physical-chemical characterization and information about the arrival of reference material to ESMA must be included in the application for certification.

6.4 A report that provides the basis for application for certification must not at the time of application be dated more than 36 months earlier.

7. Test Reports.

The reporting section must clearly and objectively include the proposed real world applications and disposal environments for which the plastic end product is being developed, with indicated exposure and lifetime expectations. The report must identify the following:

7.1 Resin grade plus the commercial name of the pro-degradant additive formulation and percentage of additive inclusion

Note: Identification of test samples needs to be sufficient to inform readers of the commercial identification of the additives and their availability in the marketplace.

7.2 The proposed disposal medium for the plastic must be indicated, with anticipated service-life and storage-life noted.

7.3 The exposure conditions such as temperature, time, moisture and oxygen concentrations shall be reported.

7.4 The exposure conditions and time of exposure ($\text{kJ/m}^2 \cdot \text{nm}$ at 340 nm) to radiation, if used, must be recorded.

7.5 Molecular weight, tensile elongation and percentage of gels of the samples before and after the indicated time for abiotic test exposure shall be reported.

7.6 Mass before and after the test shall be reported.

7.7 Extent of biodegradation, expressed as a percentage of theoretical carbon, to be reported.

7.8 Percentage of gel or other non-degradable fractions, to be reported.

7.9 Volatiles produced by the oxidation process, to be reported.

7.10 Additions of inoculants and moisture and their timing and any additional mixing procedures to be reported.

7.11 Regulated metal concentrations are to be reported.

8. Certification & Verification

8.1 Certification requires confirmation by an independent accredited third party that a material or product fulfils the requirements specified in this Standard.

8.2 All tests are required to be performed at accredited laboratories as per ISO guidelines.

9. Use of Certification marks.

9.1 After approval by ESMA, manufacturers shall use the symbols prescribed by ESMA to mark their polymeric material and polymeric product as being oxo-biodegradable.

9.2 Continuous quality control is to be done by the manufacturer. ESMA shall inspect the manufacturer's quality control system during visits to the production site. Unannounced inspections at the production site or at locations where the product is for sale may also be made by ESMA. The main purpose for the control is to ascertain that the quality requirements for certified waste management of the polymeric materials or products are fulfilled. During these inspections, samples may be taken for subsequent testing.

10. Useful Life.

10.1 All articles meant for use by consumers, and certified to be oxo-biodegradable, shall carry a "use by" marking so as to forewarn the consumer about the useful life after which the article is liable to start degrading.

10.2 The useful life should be a minimum of 6 months in storage away from direct sources of light and heat, and of a further 6 months in use.