Australian Standard®

Degradability of plastics—Methods of test

Method 4: Test method for heat aging of degradable plastics

PREFACE

This Standard was prepared by Standards Australia's Committee EV-017, Degradability of Plastics.

This Standard forms a part of a series of test methods and performance standards to enable certification bodies to validate and if appropriate, support claims. Test methods in the series include:

AS
4828 Degradability of plastics—Methods of test
4282.1 Method 1: Determination of level of prodegradant ions
4828.2 Method 2: Determination of brittle point in plastic films using a tensile elongation test
4828.3 Method 3: Test method and criteria for ultraviolet laboratory exposure of degradable plastics
4828.4 Method 4: Test method for heat ageing of degradable plastics
4828.5 Method 5: Outdoor exposure testing of degradable plastics

This Standard is based on but not equivalent to ASTM D5510, Standard practice for heat aging of oxidatively degradable plastics.

FOREWORD

Some plastics contain chemical additives that, when exposed to sufficient levels of ultraviolet radiation, or heat, accelerate the oxidation of the polymer and thus promote the degradation of the physical properties of the plastic, ultimately leading to disintegration.

Degradable plastics exposed to heat may be subject to many types of physical and chemical changes. The severity of the exposures in both time and temperature determines the extent and type of change that occurs. Short exposure times at elevated temperatures generally serve to shorten the induction period of degradable plastics during which the depletion of antioxidants and stabilizers occurs. Physical properties, such as tensile and impact strength and elongation and modulus, may change during this induction period; however, these changes are generally not a function due to molecular-weight.

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Generally, short exposures at elevated temperatures may drive out volatiles such as moisture, solvents, or plasticizers; relieve moulding stresses; advance the cure of thermosets; increase crystallinity; and cause some change in colour of the plastic or colouring agent, or both. Normally, additional shrinkage should be expected with a loss of volatiles or advance in polymerization.

Some plastic materials such as PVC may become brittle due to loss of plasticizers or to molecular breakdown of the polymer. Polypropylene and its copolymers tend to become very brittle as molecular degradation occurs, whereas polyethylene tends to become soft and weak before it embrittles with resultant loss in tensile strength and elongation.

Effects of exposure may be quite variable, especially when samples are exposed for long intervals of time. Factors that affect the reproducibility of data are the degree of temperature control of the enclosure, humidity of the oven, air velocity over the specimen, and exposure period. Errors in exposure are cumulative with time. Certain materials are susceptible to degradation due to the influence of humidity in long-term tests. Materials susceptible to hydrolysis (that is, hydrolytically degradable plastics) may undergo degradation due to moisture when subjected to long-term thermal tests due to moisture.

It is possible for many temperature indices to exist, in fact, one for each failure criterion. Therefore, for any application of the temperature index to be valid, the thermal-aging program must duplicate the intended exposure conditions of the end product. If the material is exposed in the end use in a manner not evaluated in the aging program, the temperature index thus derived is not applicable to the use of the material.

In some situations, a material may be exposed to one temperature for a particular period of time, followed by exposure to another temperature for a particular period of time. This test can be used for such applications. The heat-aging curve of the first temperature should be derived, followed by the derivation of the heat-aging curve for the second temperature after exposure of samples to the first temperature.

There can be very large errors when equations or graphs based on data from experiments at a series of temperatures are used to estimate time to produce a defined property change at some lower temperature. This estimate of time to produce the property change or failure must always be accompanied by a 95% confidence interval for the range of times possible based on the calculation or estimate.

The correlation of results obtained from this Standard to actual environments has not been determined. The results, therefore, should be used only for comparative and ranking purposes.

METHOD

1 SCOPE

This Standard specifies a test method for determining rates of ageing due to heat exposure in degradable plastics.

After being subjected to the heat exposure, the plastic specimens are tested under AS 4828.2 to determine a brittle point.

This Standard does not predict thermal aging characteristics where interactions between street, environment, temperature, and time control failure are factors.

The results of this test method are to be used for comparative and ranking purposes of test specimens only.

