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BSI Standards Publication

Plastics — Method of controlled acceleration of laboratory weathering by increased irradiance

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National foreword

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Plastics — Method of controlled acceleration of laboratory weathering by increased irradiance

Plastiques — Méthode d'accélération contrôlée du vieillissement en laboratoire par irradiance accrue

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

Introduction

A realization of the acceleration of laboratory weathering under controlled conditions is an essential requirement for delivering reliable and fast prediction of material durability. In this connection, the correlation to real use aging behaviour is being checked constantly.

The fundamental parameters of a weathering test are simulated solar radiation, heat and moisture. The induced change in the material properties, among other things, is determined by the irradiance level and relative spectral irradiance of simulated solar radiation incident on the material surface during the test, the surface temperature, and the level of moisture. An increase in some well-known weather parameters, continuously monitored outdoors, offers opportunities to speed up the weathering process outdoors and in the laboratory. Since 1967, acceleration of outdoor weathering with instruments for intensified weathering using concentrated solar radiation (according to ISO 877-3) became a common practice. By concentrating the natural solar radiation with Fresnel mirrors, irradiances of five to six times higher than the maximum natural level has been reached. Already in 1996, a screening procedure with very high irradiances for dyed textiles were developed which enabled the reduction of the test duration for lightfastness grades from five days to seven days to two and a half days.[5]

However, the applicability of an increased irradiance for deterministic acceleration of weathering without a specific knowledge of material properties requires that the degradation of material (at constant temperature and moisture conditions) has to be dependent on the applied radiant exposure only, irrespective of the irradiance level and resulting exposure duration used during the test. For some materials fulfilling this criterion, the acceleration of weathering has been demonstrated successfully.[6][7][8][9] This criterion is not always fulfilled since an increase in the irradiance might not always produce the expected increase in the weathering acceleration due to possible and a priory unknown to the operator nonlinear dependence of the photochemical processes on the irradiance level. Moreover, the overall material degradation might be strongly affected by the other weather parameters which can be modified due to the increased irradiance.

There are limitations in using increased irradiances. Therefore, the applicability and the limits of this weathering acceleration approach are determined by the properties of the specific material and have to be investigated systematically in each particular case. In this respect, it is of essential importance to validate an appropriate test procedure under controlled conditions in laboratory with an artificial radiation source which can provide high irradiances above the natural level with the relative spectral irradiance closely mimicking the natural solar radiation. Simultaneously, the temperature of the sample specimen surface and of the chamber air is kept constant in a wide range of irradiance level. In addition, the usual wetting and rain options have to be available.

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1 Scope

This Technical Specification specifies a test method which allows predicting the aging rate of material specimens, e.g. plastics, under interest independent of the aging mechanisms as a function of radiant exposure. The UV irradiance of a simulated solar radiation (with a laboratory radiation source) will be extended above the normal maximum level on earth surface while keeping all relevant temperature parameters fixed.

NOTE For translucent plastics, the surface temperatures are below the white standard temperature. In addition, the maximum temperature is not on the irradiated surface, it is somewhere inside the plastic material.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or artificial light*

ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

ISO 10640, *Plastics — Methodology for assessing polymer photo ageing by FT-IR and UV-visible spectrometry*

ISO/TR 17801, *Plastics — Standard table for reference global solar spectral irradiance at sea level — Horizontal, relative air mass 1*

CIE Publication No. 85:1989 *Solar spectral irradiance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
radiant exposure
H
radiant energy per unit

Note 1 to entry: Radiant exposure is given by the following formula:

$$H = \int E \times \mathrm{d}t$$

where

E is the irradiance, in watts per square metre ($W \times m^{-2}$);

t is the exposure time, in seconds (s).

Note 2 to entry: H is therefore expressed in joules per square metre ($J \times m^{-2}$).