SLOVENSKI STANDARD
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Polimerni materiali - Metoda za pospešeno umetno staranje z uporabo živosrebrne svetilke s srednjim parnim tlakom

Plastics - Method for artificial accelerated photoageing using medium pressure mercury vapour lamps

Kunststoffe - Verfahren zur künstlich beschleunigten Alterung bei Verwendung von Quecksilberdampflampen

Plastiques - Méthode de photovieillissement artificiel accéléré utilisant des lampes à vapeur de mercure à moyenne pression

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Plastiques - Méthode de photovieillissement artificiel accéléré utilisant des lampes à vapeur de mercure à moyenne pression

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Foreword

This document (EN 16472:2014) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2014 and conflicting national standards shall be withdrawn at the latest by October 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Introduction

When a polymeric material is exposed to natural UV radiation and other moderate environmental stresses, the change in most physical properties is attributable to chemical ageing, and the extent of the chemical changes can be related to the duration of the exposure under natural outdoor weathering conditions.

This method attempts to maximize the acceleration of photoageing using elevated UV irradiance and temperature that still keep the fundamental photoageing mechanism equivalent to that found in natural ageing. Temperature increase above the natural level should be limited so that the photothermal transformation exceeds any pure thermal conversion. A medium pressure mercury lamp, with radiations of wavelength lower than 290 nm properly filtered out, gives a relevant source with high UV emission intensity and low IR emission.

One of the main interests in use of artificial accelerated photoageing tests is to able to provide a relevant lifetime estimate of polymeric materials exposed in natural outdoor conditions.

The relevance of artificial ageing can be determined by comparing the chemical changes that occur in the accelerated test to those that occur in natural weathering (see ISO 10640). Kinetic analysis is recommended to determine the rate of degradation under different conditions of ageing in order to rank different formulations or to determine the range of acceleration possible for an artificial ageing test compared to a given natural outdoor weathering exposure (without distortion of the photodegradation mechanism of the polymer).

Chemical changes control the degradation of mechanical properties and contribute to changes in the visual appearance of polymer materials during photoageing. These chemical changes may be analysed primarily by IR spectroscopy, with additional analyses using UV/visible spectroscopy during the photoageing of polymers.

1 Scope

This European Standard specifies a method for carrying out artificial accelerated photoageing of test specimens by exposing them to medium pressure filtered mercury vapour lamp as light source, under controlled temperature conditions.

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.

EN ISO 4892-1:2000, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance (ISO 4892-1:1999)*

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

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

ISO 10640, *Plastics — Methodology for assessing polymer photoageing by FTIR and UV/visible spectroscopy*

3 Terms and definitions

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

3.1
control
material which is of similar composition and construction to the test material and which is exposed at the same time for comparison with the test material

Note 1 to entry: An example of the use of a control material would be when a formulation different from one currently being used is being evaluated. In that case, the control would be the plastic made with the original formulation.

[SOURCE: EN ISO 4892-1:2000]

3.2
reference material
material of known performance

4 General

When correctly powered and maintained, the plasma of a medium pressure mercury arc discharge emits mainly UV and the visible radiation.

This lamp allows the acceleration of the photochemical process by high UV irradiance without high infrared emission.

Specimens of the samples to be tested are exposed to the laboratory light source under controlled temperature condition. The temperature activates the photochemical process.

Optionally, the samples can be exposed to immersion and/or dark periods. The design of the equipment shall achieve the appropriate specifications as well as the UV irradiance (radiant exposure) and temperature set points.

For comparing the performance of the test material to that of the control, it is recommended that at least one control be exposed during each test.

5 Apparatus

5.1 Laboratory light source

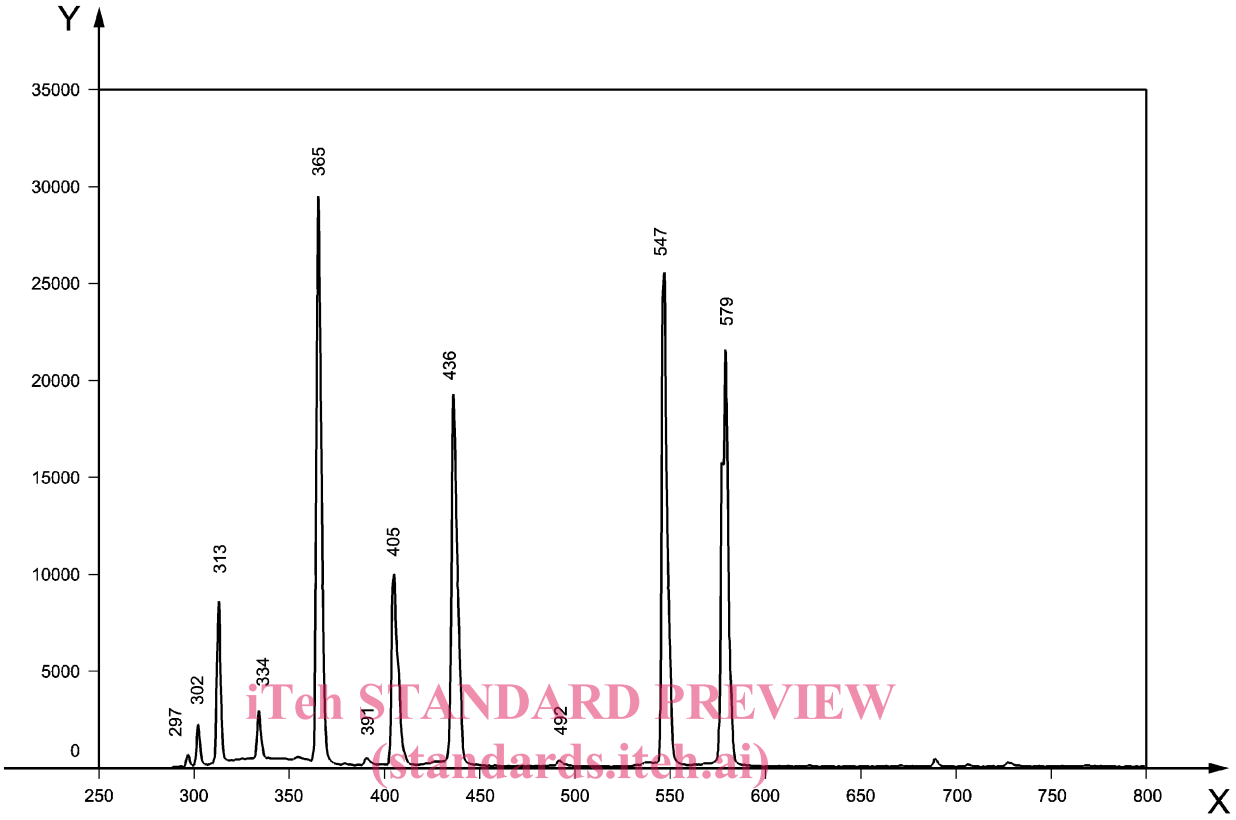
5.1.1 General

Medium pressure mercury vapour lamps consist of a quartz burner filled with a mixture of gas and mercury where the discharge takes place, the burner being located in a borosilicate bulb.

These lamps are available in different power categories.

The radiation they emit consists of lines of variable intensity within the range from 250 nm to 800 nm. Irradiance at wavelengths shorter than 290 nm is filtered out by the bulb. Therefore only lines at wavelength 297 nm, 302 nm, 313 nm, 334 nm, 365 nm, 391 nm, 405 nm, 436 nm, 492 nm, 547 nm and 579 nm remain.

A typical filtered spectrum of a medium pressure mercury vapour lamp is shown in Figure 1.



Key

X wavelength, nm

Y spectral irradiance, $mW \cdot m^{-2} \cdot nm^{-1}$

Figure 1 — Typical spectrum of a filtered medium pressure mercury vapour lamp

The filtered light emitted by a medium pressure mercury-arc does not simulate full spectrum sunlight but can be used to investigate photochemical phenomena. The relevancy to outdoor data shall be carefully considered. The only requirement is a relevant control of the chemical change in the solid state under polychromatic light.

Additional optical filters may be used for specific applications. Annex A provides information on additional filtering of lamp UV radiations.

Ensure the lamp has been pre-aged for 100 h prior to use, since the transmittance spectrum of borosilicate bulb may change significantly during this initial period.

NOTE Commonly, the light output (intensity and wavelength) does not vary more than 20 % during the lifetime of the lamps (see 5.4 or 8.1).

5.1.2 Spectral irradiance of medium pressure mercury vapour lamps

The minimum and maximum levels of the relative spectral irradiance in the UV region are given in Table 1.