



BSI Standards Publication

Plastics — Determination of apparent activation energies of property changes in standard weathering test methods

National foreword

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Foreword

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

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Introduction

Temperature is an important influencing factor on correlation and acceleration in lightfastness and weathering testing. This is acknowledged in international general weathering standards like ISO 4892-1 or ISO 16474-1.

The Arrhenius concept describes the influence of temperature on the reaction rate of chemical reaction. This model is also used (with limitations) to describe the reaction rate of photochemical/weathering reactions. Several assumptions and limitations should be taken into account; the Arrhenius concept might not be sufficient to describe complex degradation behaviours. However, this basic approach might help to better understand the influence of temperature on weathering degradation of polymeric materials.

An important material specific property to describe the temperature influence on degradation reactions is the activation energy E_a , which describes the required energy barrier for a chemical reaction to occur. E_a is only valid for a specific material and a specific degradation pathway. In weathering, this degradation pathway is usually attributed to a specific property change.

The Arrhenius principle is applied to determine the temperature dependency of the thermal degradation of polymers. The thermal activation energy can be calculated based on ISO 11358-2. There is no such standard to determine the activation barrier for weathering or photo-chemical degradation of polymers.

Limited information is available on the activation energies of photochemical degradation/weathering reactions. To determine activation energies, weathering experiments at least at two different temperatures are required. Due to this high effort, available activation energies are often calculated based on unsuitable weathering experiments (for example based on outdoor weathering and accelerated weathering).

There are some basic test requirements which help to increase the significance of the Arrhenius concept and the determination of the activation energy in accelerated weathering. These requirements are described in this document.

NOTE 1 Different property changes, for example yellowing and surface cracking of one material can have different activation energies.

NOTE 2 In this approach, the activation energy is considered as temperature independent for the selected temperature range.

The determination of activation energies of photo-chemical degradation processes allows including the temperature into the evaluation and correlation of different weathering experiments as quantitative factor. Knowing the activation energy improves the reliability and predictive value of artificial weathering.

NOTE 3 The use of the Arrhenius concept in artificial weathering simplifies complex chemical degradation processes and is therefore, in this context, a limited model to estimate the temperature dependency in weathering. However, by following some basic experimental preconditions, the relevance of the estimates can be increased.

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