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Plastics — Thermogravimetry (TG) of polymers —

Part 2: Determination of activation energy

Plastiques — Thermogravimétrie (TG) des polymères —

Partie 2: Détermination de l'énergie d'activation

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

This third edition cancels and replaces the second edition (ISO 11358-2:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the designation of rate of conversion has been changed in order to match that used in ISO 11358-3;

— the purge gas requirements have been changed with a reference to ISO 11358-1.

A list of all parts in the ISO 11358 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Plastics — Thermogravimetry (TG) of polymers —

Part 2: Determination of activation energy

1 Scope

This document specifies a method for the determination of the activation energy, E_a, in the Arrhenius formula for the decomposition of polymers using a thermogravimetric technique. The method is applicable only if the reaction proceeds by a single mechanism. It is applicable to multistage reactions if they consist of clearly separated single-stage steps.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11358-1, *Plastics — Thermogravimetry (TG) of polymers — Part 1: General principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11358-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp
— IEC Electropedia: available at http://www.electropedia.org/

3.1
Arrhenius formula
formula representing the temperature dependence of the rate constant of a reaction

Note 1 to entry: The rate constant, k, of a reaction is expressed by the Arrhenius formula, as follows:

$$k = A \cdot \exp^{(-E_a/RT)}$$

where

R is the gas constant (= 8,314 J · K^{-1} · mol^{-1});

T is the absolute temperature, in kelvins (K);

A is the pre-exponential factor, in reciprocal seconds (s^{-1});

E_a is the activation energy, in J · mol^{-1};

k is the rate of reaction (= dC/dt), in reciprocal seconds (s^{-1}).

3.2
activation energy
E_a
energy, above that of the ground state, which must be added to an atomic or a molecular system to allow a particular process to take place

Note 1 to entry: It is expressed in $J \cdot mol^{-1}$.

3.3
degree of conversion
C
quantity of products present at a particular time and temperature during a reaction compared with the final quantity of the products

Note 1 to entry: It is given by the formula:

$$C = (m_i - m_t)/(m_i - m_f)$$

where

m_i is the initial quantity, in milligrams;

m_t is the quantity at a particular time and temperature, in milligrams;

m_f in the final quantity, in milligrams.

Note 2 to entry: When multistage reactions occur, the degree of conversion is calculated separately for each stage.

Note 3 to entry: The degree of conversion is dimensionless and varies in value from 0 to 1.

4 Principle

Test specimens are heated at several different heating rates and the change in mass measured as a function of temperature. The temperatures corresponding to given degrees of conversion are determined for each heating rate. For a given degree of conversion, the logarithm of the heating rate is plotted against the reciprocal of the absolute temperature, and the activation energy is calculated from the slope of the straight line thus obtained.

5 Apparatus

According to ISO 11358-1.

6 Mass and temperature calibration

6.1 Mass calibration

According to ISO 11358-1.

6.2 Temperature calibration

According to ISO 11358-1.

7 Test specimens

The test specimens shall be in the form of powder, pellets, flakes, filaments or film. The test specimens shall be prepared by cutting the material, as necessary, to a size appropriate for the apparatus (see