

Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography —

Part 1: General principles

ICS 83.080.01

National foreword

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Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size- exclusion chromatography —

Part 1: General principles

*Plastiques — Détermination de la masse moléculaire moyenne et de la
répartition des masses moléculaires des polymères par
chromatographie d'exclusion stérique —*

Partie 1: Principes généraux



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Foreword

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ISO 16014-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

ISO 16014 consists of the following parts, under the general title *Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography*:

- *Part 1: General principles*
- *Part 2: Universal calibration method*
- *Part 3: Low-temperature method*
- *Part 4: High-temperature method*

Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography —

Part 1: General principles

1 Scope

This part of ISO 16014 specifies a general method for determining the average molecular mass and the molecular mass distribution of polymers using size-exclusion chromatography (SEC). The average molecular mass and the molecular mass distribution are calculated from a calibration curve constructed using polymer standards. Therefore this method is classified as a relative method (see Clause A.1 in Annex A).

2 Normative references

The following referenced documents are indispensable for the application 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 472, *Plastics — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following apply.

3.1

size-exclusion chromatography

SEC

a liquid chromatographic technique in which the separation is based on the hydrodynamic volume of molecules eluting in a column packed with porous non-adsorbing material having pore dimensions that are similar in size to the molecules being separated

NOTE The term gel permeation chromatography (GPC) should only be used where the porous non-adsorbing packing material is a gel; however, the term size-exclusion chromatography (SEC) is preferred.

3.2

molecular mass

M

sum of the masses of the atoms making up a molecule

NOTE Molecular weight is also used for molecular mass.

3.3 Average molecular mass

Four types of average molecular mass are defined by the following equations, where N_i is the number of molecules of species i of molecular mass M_i and a is the exponent of the Mark-Houwink-Sakurada equation.

3.3.1 number-average molecular mass

$$M_n = \frac{\sum_{i=1}^{\infty} (N_i \times M_i)}{\sum_{i=1}^{\infty} N_i} \quad (1)$$

3.3.2 mass-average molecular mass

$$M_w = \frac{\sum_{i=1}^{\infty} (N_i \times M_i^2)}{\sum_{i=1}^{\infty} (N_i \times M_i)} \quad (2)$$

3.3.3 z-average molecular mass

$$M_z = \frac{\sum_{i=1}^{\infty} (N_i \times M_i^3)}{\sum_{i=1}^{\infty} (N_i \times M_i^2)} \quad (3)$$

3.3.4 viscosity-average molecular mass

$$M_v = \left[\frac{\sum_{i=1}^{\infty} (N_i \times M_i^{a+1})}{\sum_{i=1}^{\infty} (N_i \times M_i)} \right]^{1/a} \quad (4)$$

4 Principle

A polymer sample is dissolved in a suitable solvent to make a dilute solution. This solution is injected into the mobile phase and onto the SEC column, which is packed with non-adsorbing material made up of small particles having pores of similar or varying size. As the polymer sample passes through the column, the polymer molecules are separated from each other according to the difference in their molecular masses, or more precisely, the difference in their molecular sizes (i.e. their hydrodynamic volume). In SEC, the larger-size molecules cannot permeate into the pores, and thus elute faster, while smaller molecules can permeate into the pores and elute more slowly. The polymer concentration in the eluate is continuously monitored by a concentration-sensitive detector to give an SEC chromatogram.