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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 46831-2025

**Plastics - Determination of isotactic index for polypropylene
(PP) - Low-resolution nuclear magnetic resonance
spectrometry**

塑料 聚丙烯 (PP) 等规指数的测定 低分辨率核磁共振波谱法

(English Translation)

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is modified to adopt ISO 24076:2021 "Plastics - Polypropylene (PP) - Determination of isotactic index by low resolution nuclear magnetic resonance spectroscopy".

The technical differences between this document and ISO 24076:2021, and the reasons therefor, are as follows.

a) ISO 9113 (see Chapter 4, 7.1.1, 7.2.1 and 8.2.1) has been replaced with the normatively referenced GB/T 2412 to adapt to my country's national standards.

Technical conditions, increasing operability;

b) The requirement for footnotes to be allowed in the main text has been revised (see 5.1, 5.2, 7.1.2.4, 8.1.2.1, 8.1.2.4) to make this document more scientific and reasonable;

c) The requirements for the vacuum drying oven have been changed from "should be maintained at $140^{\circ}\text{C}\pm 2^{\circ}\text{C}$ " to "temperature control range of $50^{\circ}\text{C}\sim 150^{\circ}\text{C}$, temperature control..." the accuracy is $\pm 2^{\circ}\text{C}$ (see 5.3) to adapt to my country's technical conditions and increase operability;

d) The thermostat requirement has been changed from "should maintain $40^{\circ}\text{C}\pm 0.1^{\circ}\text{C}$ " to "can maintain $40^{\circ}\text{C}\pm 0.1^{\circ}\text{C}$ or the same as the probe temperature".

"Other consistent temperatures" (see 5.4) to adapt to my country's technical conditions and increase operability;

- e) The conditions for sample preparation were changed to make the experiment more scientific and reasonable (see 6.1);
- f) Added information that should be included in the test report, namely "sample preparation conditions" (see Chapter 10).

The following editorial changes have been made to this document.

---ISO 19069-1 (see Chapter 1) has been replaced by GB/T 2546.1, which is cited in the informational reference.

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed by the China Petroleum and Chemical Industry Federation.

This document is under the jurisdiction of the National Technical Committee on Plastics Standardization (SAC/TC15).

Introduction

The method for determining the isotactic index of polypropylene using low-resolution nuclear magnetic resonance spectroscopy in this document is based on GB/T 2412.

GB/T 2412 specifies the definition and determination method of the isotactic index of polypropylene, namely, the isotactic index of polypropylene samples is separated into extractable polypropylene using the n-heptane extraction method.

Extractable and non-extractable components are defined, with the percentage of non-extractable components by mass in the sample being the isotactic index of the sample.

The isotactic index in GB/T 2412 and the concepts and test results of isotacticity (stereoregularity or stereoregularity) of polymer chains are both...

They are not the same. The isotacticity of molecular chains is generally determined by high-resolution C-13 nuclear magnetic resonance and infrared spectroscopy. The test results in GB/T 2412...

The result is related not only to the isotacticity of the sample's molecular chains, but also to factors such as the sample's crystallinity, molecular weight, chain entanglement, and solvent solubility.

For solid polymers, solvent extraction typically requires a long time for long-chain polymers to migrate into the solvent. To improve...

To improve testing efficiency, a non-destructive testing method for determining isotactic indices using low-resolution nuclear magnetic resonance spectroscopy was developed. This document establishes a method for testing polypropylene...

The isotactic index of the sample was calculated by comparing the NMR attenuation signal of the olefin with the working curve of the isotactic index of polypropylene determined by GB/T 2412.

Once established, this method eliminates the need for solvents during testing, thus improving testing efficiency.

Determination of the isotactic index of polypropylene (PP) plastic Low-resolution nuclear magnetic resonance spectroscopy

1 Scope

This document describes a method for determining the isotactic index of polypropylene (PP) using low-resolution nuclear magnetic resonance (LR-NMR).

This document applies to thermoplastic propylene homopolymers (PP-H) as specified in GB/T 2546.1.

This document does not apply to blends.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included.

For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies.

This document.

GB/T 2412 Plastics - Determination of the isotactic index of thermoplastic plastics such as polypropylene (PP) and propylene copolymers (GB/T 2412-2008, ISO 9113:1986, MOD)

3 Terms and Definitions

The following terms and definitions apply to this document.

isotactic index

The mass fraction of components that cannot be extracted from polypropylene using boiling n-heptane.

4 Principles

The sample was placed in a low-resolution nuclear magnetic resonance spectrometer (LR-NMR). After the LR-NMR static magnetic field reached electromagnetic equilibrium, a 90° beam was applied.

Frequency pulses were used to record the NMR decay signal curves of protons in the sample. The NMR signal intensity of the non-extractable component in the sample decayed compared to that of the extractable component.

It needs to be fast. In the NMR signal curve, the initial NMR signal corresponds to the whole sample containing both non-extractable and extractable components, and the later signal decays slowly.

The reduced signal corresponds to the extractable components in the sample. Therefore, a standard can be established between the sample's NMR signal and the isotactic index determined in GB/T 2412.

The isotactic index of the sample is determined by the curve.

Method A - Ratio Method. This method compares the ratio of the NMR decay signal of the non-extractable component in the standard sample to that of the whole sample with the extraction method's isotropic index.

A standard curve is established, and the isotactic index of the sample is calculated. Method B-the absolute value method-uses the extractable fraction per unit mass of the standard sample.

A standard curve was established by comparing the nuclear magnetic resonance attenuation signal with the isotactic index of the extraction method, and the isotactic index of the sample was calculated.

5.1 LR-NMR

The frequency is 18MHz~25MHz, typically 20MHz and 23MHz; the probe diameter for method A is 10mm, and the probe diameter for method B is...