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Plastics Testing and Characterization

Industrial Applications



HANSER

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PREFACE

Designed to provide a polymer materials testing and characterization background to both engineering students and practicing engineers, this book is written at an intermediate level with the technical information and industrial applications needed for an engineer to make the right decisions regarding testing methods, as well as troubleshoot problems encountered in polymer characterization and processing.

Testing and Characterization of Plastics is based on lecture notes from the graduate program Processing of Plastics and Rubber at EAFIT University and the polymer engineering courses at the University of Wisconsin-Madison, as well as the consulting and research and development activities at the Rubber and Plastic Institute for Training and Research (ICIPC) done for the plastics and rubber industry.

The organization of the book, the clear presentation of data, and the industrial case studies in polymer characterization and testing make it an ideal reference book for engineering students and practicing engineers. The information is particularly valuable to part designers, processors, and raw materials suppliers.

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CHAPTER 1

INTRODUCTION

This book is designed to provide a background in polymer properties and testing in the areas of characterization and processing to engineering students and practicing engineers. The basic properties of interest and the testing and characterization techniques used to measure them are presented.

Combined with a solid engineering background, this book has the information and industrial case studies an engineer needs to both make informed decisions about selecting appropriate testing techniques and effectively troubleshoot problems in the field of plastics technology. The scope of this book also includes relevant and concise information for data interpretation using the most important characterization techniques.

1.1 TESTING TECHNIQUES

Polymer testing and characterization involves several analytical techniques that evaluate the physical and chemical structure of polymers and their additives. This field is important in several industrial and scientific areas, including quality assurance of polymers and additives, research and development of new materials, design of polymeric formulations, analysis of unknown samples, reformulations, and troubleshooting.

Today, the different instrumental analysis techniques have rapidly changed because of the advances in electronics and computers that allowed the introduction of new characterization equipment and methods for improving existing techniques. The main technological trends in polymer testing and characterization are:

- Easier sample preparation
- On-line measuring and data acquisition
- Automation by means of microprocessors and computers
- Sensitivity enhancement (better signal/noise ratio)
- Lower detection limits
- Accuracy and precision improvement
- Miniaturization
- Instruments that are easier to operate
- Databases and specialized software that facilitate result analyses
- Remote diagnosis and configuration (via Internet)
- Modular and flexible equipment, "Plug and Play" setup
- Important reduction of instrument cost

This book is broken down into the following categories of techniques and properties:

- Fourier transform infrared spectroscopy (FTIR)
- Raman spectroscopy
- Energy dispersive X-ray spectroscopy
- Gas chromatography and selective mass detection (GC/MSD)
- Thermal properties
 - Thermal conductivity
 - Specific heat
 - Density
 - Thermal diffusivity
 - Linear coefficient of thermal expansion
 - Curing behavior of thermosets and elastomers
 - Differential scanning calorimetry (DSC)
 - Thermogravimetical analysis (TGA)
- Melt rheology
- Mechanical properties
- Permeability properties
- Aging
- Electrical properties
- Optical properties
 - Imaging techniques (Introduced in various examples throughout the book)

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