

Modern Technology of Plastic & Polymer Processing Industries

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The Indian plastic and polymer industry has taken great strides. In the last few decades, the industry has grown to the status of a leading sector in the country with a sizable base. The material is gaining notable importance in different spheres of activity and the per capita consumption is increasing at a fast pace. Continuous advancements and developments in polymer technology, processing machineries, expertise and cost effective manufacturing is fast replacing the typical materials in different segments with plastics. Plastics play a very important role in our daily lives. Throughout the world the demand for plastic, particularly plastic packaging, continues to rapidly grow. Polymer processing industry deals with the manufacture and production of polymer and synthetic substances for example acrylic plastics: poly (methyl methacrylate), poly vinyl chloride (PVC), polyamides, polyesters, cellulose plastics etc. Plastic is incredibly versatile and can be made from different ingredients, moulded into any shape, and put to a huge range of uses across industry and the rest of society. Polymer Energy system is an award winning, innovative, proprietary process to convert waste plastics into renewable energy. Polymers are the most rapidly growing sector of the materials industry. No wonder polymers are found in everything from compact discs to high tech aerospace applications. On the basis of value added, Indian share of plastic products industry is about 0.5% of national GDP.

This book majorly deals with properties and applications of engineering, the strength of thermoplastic composites, and the application of thermoplastic structural composites, applications of differential scanning, calorimetry and polymer characterization, polymer degradation and stabilization, advances in photo degradation and stabilization of polyurethanes and so on. This book also consists of raw material suppliers for plastic and plastic products, manufacturers of plastic processing machinery, plastics processing machinery and equipment (foreign), machinery and equipment for plastic converting, extruders and extrusion lines, injection moulding machines and so on.

This book offers, in standardized and readily accessible information on the synthesis, structure, properties and applications of the most important polymeric materials. It has been designed as a text giving a balanced coverage of the science and technology of polymers finding major applications plastics. This book is very useful for industrialists, consultants, research scholars and institutes.

1. PROPERTIES AND APPLICATIONS OF ENGINEERING THERMOPLASTICS

Polyethylene Terephthalate (PET)

Applications

Polybutylene Terephthalate (PBT)

Characteristics

Applications

Polyamides (PA)

Characteristics

Applications

Polyoxymethylenes (POM)

Characteristics

Applications

Polycarbonate (PC)

Characteristics

Applications

2. THE STRENGTH OF THERMOPLASTIC COMPOSITES

Compression strength

The Tensile Strengths of Uniaxial Laminates

The Tensile Strengths of Cross-ply Laminates

Shear Strengths

Technological Tests

3. TEMPERATURE SENSITIVITY

The Effect of Temperature on Stiffness

The Influence of Temperature on Strength

Toughness and Temperature

Fire Resistance

4. THE APPLICATIONS OF THERMOPLASTIC STRUCTURAL COMPOSITES

Medical uses

Satellites and Launch Vehicles

Aircraft Structures

Marine applications

Automotive Engineering

Industrial Machinery

5. THERMAL ANALYSIS OF POLYMERIC MATERIALS

Dielectric Analyzer

Thermogravimetric Analysis (TGA)

Thermograms

High Resolution Thermogravimetric Analysis

Applications

Relative Thermal Stability

Differential Scanning Calorimetry (DSC)

6. APPLICATIONS OF DIFFERENTIAL SCANNING

CALORIMETRY AND POLYMER CHARACTERIZATION

Specific Heat Capacity Measurement

Calculations

DSC Curing Kinetics

Principle of Operation

Applications

DSC Thermal Stability Kinetics

Applications

Degree of Crystallinity and Melting Point (T_m)

Statement of the Problem

7. KINETIC STUDIES WITH DIFFERENTIAL SCANNING

CALORIMETER

Borchardt and Daniels Method

The Technique Assumes
ASTM E698 Method
Isothermal Method
Dynamic Versus Isothermal Method
Autocatalyzed versus Nth Order Kinetics
Theory and Calculations
Isothermal Method

8. THERMOGRAVIMETRY

Quality control and materials characterisation in the ceramics industry
Use of TGA to distinguish flame-retarded polymers from standard polymers
Measurement of Smoke Density by TGA/Photometric Analysis
TGA decomposition Kinetics
Applications

9. MOLECULAR WEIGHT AND DIMENSION OF POLYMERS

Concept of Average Molecular Weight
Molecular Weight Distribution
Measurement of Molecular Weight Average
Summary

10. POLYMER DEGRADATION AND STABILISATION

Types of Degradation
Other Types of Degradation
Recent Progress in the Degradation of Polyisobutylene
Introduction
Photodegradation
Oxidative Degradation
Stabilization
Sensitization
Advances in Photodegradation and Stabilization of
Polyurethanes
Introduction
Mechanism of Photodegradation
Effect of Physical State on Photodegradation
Photostabilization of Polyurethanes
Conclusion
New Developments in the Degradation, Stabilization, and
Sensitization of Poly (Methyl Methacrylate)
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Weathering
Plasma Degradation
Mechanical Degradation
Ultrasonic Degradation
Electrochemical Degradation
Radiative Degradation
Thermal Degradation
Photodegradation
Oxidative Degradation
Stabilization
Sensitization

11. CONDENSATION POLYMERIZATION OR STEP-GROWTH POLYMERIZATION

Functionality Principal
Types of Polymerization
Basic Characteristics of Condensation or Step-Growth
Polymerization

Formation of a Polyester

Relationship between Average functionality, Extent of Reaction and Degree of Polymerization

Molecular Weight Control: Quantitative Effect of Stoichiometric Imbalance on Maximum Attainable Molecular Weight

Kinetics of Step-growth Polymerization

Principle of Equal Reactivity of Functional Groups

Rate of Step-growth Polymerization

Distribution of Molecular Weight in (Linear Bifunctional Polycondensation

Derivation of Distribution Functions

Weight Average Degree of Polymerization

Multichain Step-Growth Polymers (Polyfunctional Systems)

Branching

Cross-linking

Prediction of Gel-Point

Some Additional Considerations of Non-Stoichiometric Reactant Systems

Practical Consideration of Gel Points

Molecular Weight Distribution in Multifunctional Reactant Systems

Interfacial Polymerization

12. COPOLYMERIZATION AND TECHNIQUES OF POLYMERIZATION

Concept of Copolymerization

Binary Copolymerization of Vinyl Monomers by Free Radical Mechanism

Analysis of the System and the Reactions Involved

Kinetics of Chain Propagation in Binary Copolymerization and Copolymer Composition

Significance of Monomer Reactivity Ratios

Types of Copolymerization

Ideal Copolymerization

Alternating Copolymerization

Azeotropic Copolymerization

Average Copolymer Composition

Determination of Monomer Reactivity Ratios

Rate of Copolymerization

Structure and Reactivity of Monomers and Radicals

Structure and Reactivity of Monomers

Resonance Stabilization

Radical Reactivity and Steric Effects

Polar Effects and Alternation

Technical Significance of Copolymerization

Block and Graft Copolymers

Techniques of Polymerizations

Bulk Polymerization

Solution Polymerization

Suspension Polymerization

Emulsion Polymerization

13. POLYMER CHARACTERISTICS AND POLYMER CHARACTERIZATION

The Structure of Vinyl and Related Polymers

Prevalence of Head-to-Tail Structure in Vinyl Polymers

Branching in Vinyl Polymers

Polymer Degradation
Thermal Degradation
Depolymerization
Substituent Roles
Mechanochemical Degradation
Aging or Oxidative Degradation
Photodegradation
The Concept of Average Molecular Weight
Viscosity Average Molecular Weight
General Expression for Viscosity Average Molecular Weight
Number Average Molecular Weight
Membrane Osmometry
Weight Average Molecular Weight : Light Scattering by
Polymer Solutions
Dissymmetry
End-Group Analysis
Dye Partition Technique
Dye Interaction Technique
The Z Average Molecular Weight
General Requirement of Extrapolation to infinite Dilution
Polymer Fractionation and Molecular Weight Distribution
Gel Permeation Chromatography
The Molecular Size Parameter
Molecular Weight Distribution in Vinyl Polymers
Thermal Analysis
Other Methods and Techniques of Polymer Characterization

14. PLASTICS: MATERIALS AND PROCESSING TECHNOLOGY

Plastics Materials - Introduction
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Low Density Polyethylene (LDPE)
High Density Polyethylene (HDPE)
Structure and Properties of Polyethylenes
Uses and Applications of Polyethylenes
Chlorosulphonated Polyethylene
Linear Low Density Polyethylene (LLDPE)
Polypropylene
Synthesis of Polypropylene
Structure and Properties of Polypropylene
Copolymers of Ethylene
Polystyrene
Monomer Synthesis
Polymerization of Styrene
Structure and Properties of Polystyrene
Modification to High Impact Grades
Styrene-Acrylonitrile (SAN) Copolymers and ABS Resins
Processing, Uses and Applications of Polystyrene
Acrylic Plastics: Poly (Methyl Methacrylate)
Acrylic Fibres
Poly (Vinyl Acetate)
Polymers Derived from Poly(Vinyl Acetate)
Poly(Vinyl Chloride)
Preparation of Vinyl Chloride

Polymerization of Vinyl Chloride
Structure and Properties of PVC
Compounding and Processing of PVC
Applications of PVC
Copolymers of Vinyl Chloride
Polytetrafluoroethylene (PTFE)
Coumarone-Indene Resins
Polyacetals and Polyethers (Acetal Resins)
Polyamides
Preparation of Poly (Hexamethylene Adipamide): Nylon 66
Preparation of Nylon 6
Preparation of Nylon 11 and Nylon 12
Properties, Uses and Applications of the Nylon Polyamides
Liquid Crystalline Polymers³
Aromatic Polyamides
Polyimides
Polyesters
Alkyds for Oleoresinous Varnishes
Polyester Resins for Making Laminates and Composites
Film- and Fibre-Forming Polyester:
Poly (Ethylene Terephthalate)
Polyurethanes
Polycarbonates
Epoxy resins
Cellulose plastics
Cellulose Nitrate
Cellulose Acetate
Cellulose Ethers
Regenerated Cellulose
Phenolic Resins
Chemistry of Resin Formation
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Cast Phenolics
Miscellaneous Applications of Phenolic Resins
Amino Resins
Urea-Formaldehyde Resins
Melamine-Formaldehyde Resins
Silicones
Additives for Plastics
Fillers
Plasticizers
Stabilizers
Colouring Matters
Lubricants and Flow Promoters
Cross-linking Agents
Other Additives
Plastics Processing Technology
Moulding Techniques
Forming Techniques
Other Techniques
Chart of Properties

15. DIRECTORY

Raw Material Suppliers for Plastic and Plastic Products
Manufacturers of Plastic Processing Machinery
Plastics Processing Machinery and Equipment (Foreign)
Machinery and Equipment for Plastic Converting
Extruders and Extrusion Lines
Injection Moulding Machines
Presses and Accessories
Blow-Moulding and Thermoforming Machines
Machinery for converting Reaction Resins
(Unsaturated Polyesters, Epoxies)
Coating Lines
Other Plastics Converting Machines
Miscellaneous Plastic Machineries

About NIIR

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