

Table of Contents

- 1 Introduction to Plastics
- Definitions of Plastics and Polymers
- History of Plastics
- Raw Material Supply and Pricing
- Strategic Materials
- Plastics Industry
- Uses of Plastics in Modern Society
- Case Study
- 1.1 The Development of Nylon
- 2 Polymeric Materials (Molecular Viewpoint)
- Introduction
- Fundamentals of Matter
- Bonding
- Basic Concepts in Organic Chemistry
- Polymers
- Formation of Polymers
- Thermoplastics and Thermosets
- Copolymers
- Case Study
- 2.1 Modifications to Improve Teflon? Processing
- 3 Micro Structures in Polymers
- Introduction
- Amorphous and Crystalline
- Solids, Liquids, and Gases
- Thermal Transitions of Polymers
- Effects of Thermal Changes on Polymers
- Polymer Length
- Molecular Weight
- Melt Index
- Shape (Steric) Effects
- Introduction
- Case Study
- 3.1 Mechanical Properties of Polyethylene (PE) as Functions of Density and Melt Index
- 4 Mechanical Properties (Macro Viewpoint)
- Mechanical Properties in Solids (Elastic Behavior)
- Mechanical Properties in Liquids (Viscous Flow)
- Viscoelastic Materials
- Plastic (High-Strain) Stress-Strain Behavior
- Creep
- Toughness and Impact Strength
- Reinforcements
- Fillers
- Toughness Modifiers
- Case Study

- 4.1 Testing of Trash Containers to Predict In-use Performance
- Environmental Resistance and Weathering
- 5 Chemical and Physical Properties (Macro Viewpoint)
- Introduction
- Chemical Resistivity and Solubility
- Permeability
- Electrical Properties
- Optical Properties
- Flammability
- Plastics Identification
- Case Study
- 5.1 Using Carbon Black to Protect Polyethylene from UV Degradation
- 6 Designing with Plastics
- Design Methodology
- Layout/Drawing
- Constraints
- Prototyping
- Material Choice
- Case Study
- 6.1 Design of Plastic Stakes for Concrete Tilt-up Walls
- 7 Thermoplastic Materials (Commodity Plastics)
- Introduction
- Polyethylene (PE)
- Polyethylene Copolymers
- Polypropylene (PP)
- Polyvinyl Chloride (PVC)
- Polystyrene (PS)
- Alloys and Blends
- Case Study
- Introduction
- 7.1 Typical PVC Formulation
- 8 Thermoplastic Materials (Engineering Plastics)
- Polyamides or Nylons (PA)
- Acetals or Polyoxymethylenes (POM)
- Thermoplastic Polyesters (PET/PBT)
- Polycarbonate (PC)
- Acrylics (PAN, PMMA)
- Fluoropolymers (PTFE, FEP, PFA)
- High-Performance Thermoplastics
- Cellulosics
- Case Study
- 8.1 Making Nonstick Electrosurgical Blades
- Thermoset Types, General Properties, and Uses
- 9 Thermoset Materials
- Introduction
- Crosslinking

- Phenolics (PF)
- Amino Plastics (UF and MF)
- Polyurethanes (PUR)
- Polyester Thermosets (TS) or Unsaturated Polyesters (UP)
- Epoxies (EP)
- Thermoset Polimides
- Case Study
- 9.1 Thermoset Composites for Wrapping Utility Poles
- 10 Elastomeric (Rubber) Materials
- Introduction
- Aliphatic Thermoset Elastomers
- Thermoplastic Elastomers (EPM and EPDM)
- Fluoroelastomers
- Silicones
- Processing of Elastomers
- Case Study
- 10.1 Elastomeric Lining for a Pump
- 11 Extrusion Process
- Introduction
- Equipment
- Normal Operation and Control of the Process
- Extrusion Problems and Troubleshooting
- Material and Product Considerations
- Postextrusion Forming
- Coextrusion
- Case Study
- 11.1 Extrusion