Principles of Polymer Science

Program Description

Plastics, fibres and rubbers have one thing in common and that is they are all polymers. A polymer, however, is a very large molecule constructed from many smaller molecules bonded to one another in a chain.

This course is designed to provide engineers and chemists working in the polymer industry with a theoretical background of materials and processes they deal with during polymer production and processing. It also increases the awareness of participants of chemical issues of concern in the polymer industry, for example, environmental, stability and degradation problems associated with polymers. Classification, identification and characterization of polymeric materials are some of the subjects that will also be reviewed.

Program Outline

- **Overview**
  - Introduction
  - Classification of Polymers
  - Polymer Structures
  - The Molecular Weight of Polymers
  - Physical States and Transitions.
- **Introduction to Polymers:**
  - Polymerization Reactions
  - Polymerization Processes
  - Polymers, Monomers, Oligomers, Repeat Units.
  - Degree of Polymerization
  - Polymerization and Functionality
  - Copolymers- Random, Graft and Block
  - Thermoplastics and Thermosets
  - Elastomers, fibers, and plastics Nomenclature
- **Crosslinking in Polymers**
  - Step Polymerization
  - Radical Chain Polymerization
- **Polymer Synthesis**
  - Condensation Polymerization
  - Addition Polymerization
  - Ionic Addition Polymerizations
- **Characterization Of Polymers**
  - Size Exclusion Chromatography, SEC
  - Gel Permeation Chromatography, GPC

- **Effects of Isomerism and Conformational Changes**
  - Constitutional Polymers- Positions and Branching
  - Configurational Isomers and Steroisomerization
  - Polymer Configurations
  - Molecular Dimensions- Radius of Gyration, end-to-end Distances
  - Rubber Elasticity- Behavior, Entropy
  - Rodlike Macromolecules
- **Polymer Processing**
  - Polymer Rheology
  - Polymer Processing
  - Viscoelasticity and Mechanical Properties
  - Polymer Blends
- **Polymer Solutions**
  - Viscosity Measurements
  - Measuring Polymer Solution Viscosity
- **Structure and Properties of Polymers**
  - Amorphousness and Crystallinity
  - Crystallinity and Polymer Structure
  - Determination Of Crystalline Content
  - Differential Scanning Calorimetry
  - The Glass Transition Temperature
  - Crystalization
  - Glass transition
- **Characterization**
  - Morphotogical and Mechanical Characterization
  - Degradation
  - Stability and Environmental Issues
  - Criteria of Selection of Polymeric Materials.
- **Manufacture Of Plastic, Fibre and Rubber Articles**
  - Fabrication of Plastic Articles
  - Rubber
- **Mechanical Properties of Polymer Solids and Liquids**
  - Thermal Transitions
  - Crystallization- Degree of Crystalinity, Microstructure
  - Glass transitions- Modulus, Structure, Measurements
  - Polymer Viscoelasticity
  - Dynamic Behavior of Thermal Transitions
  - Stress-strain tests- rate and Temperature Effects
  - Crazing of Glassy Polymers
  - Fracture, Brittleness, Rheology
  - Fabrication Processes

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