

ANALYSIS AND CHARACTERIZATION OF POLYMERS

Unit I: Molecular Characterization of Polymers

Determination of molecular weight, viscometry, end group analysis, colligative property, osmometry, light scattering technique, determination of molecular weight and molecular weight distribution, gel permeation chromatography (GPC).

Unit II: Thermal Analysis Techniques

Thermal Analysis of Polymers: Differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), thermomechanical analysis (TMA), dynamic mechanical thermal analysis (DMTA).

Unit III: X-Ray Diffraction, Microscopy and Spectroscopic Techniques

X-ray diffractometry: X-ray diffraction analysis, experimental methods, applications-Chain conformations, chain packing, disorder in the crystal, degree of Crystallinity, micro structural parameters, degree of orientations.

Principles of microscopy: Optical, SEM, TEM, AFM; Morphology of polymers, Crystallization behavior, phase separation and applications

UV/Visible Spectroscopy - Introduction, principle, Lambert law, Beer's law, theory, instrumentation, procedure, advantages, disadvantages, interpretation of spectrogram, applications-qualitative analysis, quantitative analysis; purity, cis- and trans- conformation.

Fourier transformer infrared (FTIR) spectroscopy - Introduction, principle, theory, instrumentation- ATR attachment - methods of sample preparation, advantages, disadvantages, interpretation of spectra - applications - establishment of chemical structure of polymers, reaction kinetics, polymer linkage, hydrogen bond formation, purity, copolymerization, qualitative and quantitative results – gas chromatograph (GC) - Mass spectrometer.

Nuclear Magnetic Resonance(NMR) spectroscopy - (¹H NMR and ¹³C NMR) – Introduction, Principle, theory, Spin-spin coupling, coupling constant – chemical shifts - instrumentation, procedure, method of sample preparation - applications – chemical structures, purity, tacticity. Solid state NMR – applications.

Unit IV: Specifications, Quality Control & Processability Tests

Rubber latex and dry rubber – cup viscosity, total alkalinity, total solids, dry rubber content, volatile matter, KOH number, mechanical stability and heat stability, plasticity, plasticity retention index (PRI), scorch time and cure characteristics (plastimeter, Mooney viscometer, oscillating disc rheometer)

Resins – acid value, hydroxyl value, isocyanate index, epoxy equivalent.

Text Book:

1. Hunt & James, Polymer Characterization, Chapman & Hall, London, 1993.

Refernces:

1. Chermisinoff, Polymer Characterization – Laboratory Techniques and Analysis.
2. Hunt & James, Polymer Characterization, Chapman & Hall, London, 1993.
3. Kampff, Characterization of Plastics using physical methods, Experimental techniques and pratical applications.
4. Hoffman, Rubber Technology Handbook, Hanser Publishers, Munich 1996.