

## Paper III

### POLYMER CHARACTERIZATION

**Spectroscopic Methods:** Introduction, Classification, advantages and disadvantages

**Ultra-violet/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, procedure, methods of sample preparation, advantages, disadvantages, interpretation of spectrogram and applications such as establishment of chemical structure of polymers, reaction kinetics, polymer

linkage, hydrogen bond formation, purity, copolymerization, qualitative and quantitative results.

**Thermal Methods:** Introduction, general classification, advantages of the thermoanalytical methods:

**Differential Scanning Calorimetry (DSC):** Introduction, theory, instrumentation, method of analysis, factors affecting on DSC results, advantage, disadvantage, interpretation of DSC thermograms, applications - T<sub>g</sub>, T<sub>m</sub>, determination of blends composition, purity, identification of unknown polymers, degree of crystallization, degree of cure and rate of cure studies/kinetics of curing (Brodo's method, Kissinger method, etc), plasticizers effect.

**Thermogravimetry Analyzer (TGA):** Introduction Principle, theory, instrumentation, procedure for analysis of sample, factors influence on studies, advantages, disadvantages, applications – Purity, fiber content, composition of compounded rubbers, identification of polymers/rubbers, thermal stability, thermal degradation, kinetics of thermal degradation, IPDT, etc

**Dynamic Mechanical Analyzer (DMA):** Introduction, Principle, instrumentation, procedure, advantages and applications

**Chromatographic Techniques:** Principle of Gel permeation chromatography (GPC), mechanism of separation, theory/techniques, instrumentation, molecular weight determination and distribution (MWD), purity, composition, other applications

**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.

**Morphology of polymers:** SEM, TEM, AFM, morphology, crystallization behaviour, phase separation and applications.

## **REFERENCE BOOKS**

1. **“Text book of Polymer Science”** - Fred W. Billmeyer, Jr., John Wiley & Sons, New York. 2002.
2. **“Polymer characterization”** - Physical Techniques by D.Campbell and J.R. White (Chapman and Hall).
3. **“The Identification of Plastics and Rubber”** - K.J. Saunders (Chapman and Hall).
4. **“Analysis of Rubber and Rubber like Polymers”** – William C. Wake (Maclaren and sons).
5. **“Thermal Characterization of Polymeric Materials”**, - E.A. Turi, Academic Press, NY, 1981.
6. **“Principles of Polymer Chemistry”**, P.J. Flory, Cornell University Press, Ithaca, NY 1953.
7. **“Physical Chemistry of Polymers”**, A. Tager, Mir Publishers, Moscow, 1978.
8. **“Polymer Handbook”**, J.Brandrup and E.H.Immergut, 3rd ed., John Wiley & Sons, New York, 1989.