

(4 Lect./Week)
(4 hrs. Lab/Week)
(1 Student's presentation /Week)

(Total Credits -7)

Paper 5: Polymer Rheology

1. Viscosity and polymer processing, other rheological properties of fluids, shear stresses in polymer systems, non-Newtonian flow, practical melt viscosities, flow in channels, simple shear flow, melt-flow index.
2. Types of fluids and rheological models, techniques for rheological measurements by capillary, parallel plate and cone & plate viscometers. Simple elongational flow and its significance. Dynamic flow behavior, time dependent fluid responses.
3. The elastic and viscoelastic state of polymers – viscoelasticity - relationships of various approaches taken in describing the viscous and elastic properties, Maxwell model and Voigt model, Boltzmann superposition principles, dynamic mechanical testing.
4. Mixing: Types of mixing, concept and importance of master batches. Mixing of additives with the polymers, melt compounding and calendaring.
5. Types of mixers: High speed mixer, two roll mill, internal batch mixers (Banbury, Haake), single screw & twin screw extruders, flow mechanism, analysis of flow (drag, pressure and leak flow).

Practical - Polymer III:

1. Determination of melt flow index.
2. Determination of intrinsic viscosity by Ubbelohde viscometer.
3. Determination of rheological properties of polymer melt by rheometers.
4. Measurement of resin/paint viscosity by Ford cup 4.
5. Measurement of viscosity by Brookfield Viscometer.
6. Compounding of polymers in the internal mixer and measurement of torque.

Suggested Readings:

1. Introduction to Polymer Viscoelasticity by J. Aklonis and W. J. Macknight, John Wiley & Sons (2005).
2. Polymer Science and Technology of Plastic and Rubber by P. Ghosh, Tata McGraw Hill (2010).
3. Fundamental Principles of Polymeric Materials by S.L. Rosen, Wiley-Interscience (2012).
5. Melt Rheology and Its Role in Plastic Processing by J. M. Dealy and K.F. Wissbrum, Springer (1999).
6. Applied Rheology in Polymer Processing by B. R. Gupta, Asian Books (2004).