

# AMPL09 POLYMER SCIENCE & TECHNOLOGY

## UNIT-1 HISTORICAL DEVELOPMENTS IN POLYMERIC MATERIALS,

- 1.1 Basic concepts & definitions: monomer & functionality, oligomer, polymer,
- 1.2 Repeating units, degree of polymerization, molecular weight & molecular weight distribution.
- 1.3 Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications,
- 1.4 Applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins etc.
- 1.5 Raw material for synthetic polymers: Manufacturing of various fractions of crude petroleum important for polymer industry for
- 1.6 (a) Raw Materials such as ethylene, propylene, butadiene, vinyl chloride, vinylidene dichloride, styrene, acrylic monomers like acrylic acid, acrylonitrile, methacrylic acid, methacrylates, acrylamide etc,
- 1.7 (b) Solvents such as alcohols, toluene, xylene, acetone, ketones, terpenes, chloromethanes etc. Evaluation of raw materials and reactants for synthesis & manufacturing of polymers.
- 1.8 (c) Polyacids such as phthalic acid, terephthalic acid, isomers and anhydrides etc.
- 1.9 (d) phenols, polyols and their modifications, (e) Isocyanates, (f) Amino Compounds, (g) Other petroleum based material

## UNIT-2 CLASSIFICATION OF POLYMERS THERMOPLASTIC/ THERMOSET,

- 2.1 Addition/ condensation, natural /synthetic, crystalline/amorphous, step growth /chain growth, commodity. specialty, homochain/heterochain,
- 2.2 Confirmation: homo & copolymers (detailed graft, block alt, ladder etc. & nomenclature), configuration cis/trans;
- 2.3 Tacticity, branched/ crosslinked, Classification of polymers based on end use etc.
- 2.4 Molecular weight and its distribution determination ( $M_n$  to  $M_z$  & MWD), Carothers equation, states of polymers, transition temperatures such as  $T_g$ ,  $T_c$ ,  $T_m$ , solubility parameter, solution properties, temperature, good/ bad solvent,
- 2.5 Addition, condensation polymerization mechanism (7) Surface tension/ energy & contact angle measurements of different polymeric systems & their wettability with other substances.

## UNIT-3 TECHNIQUES OF POLYMERIZATION:

- 3.1 Bulk, solution, suspension, emulsion, plasma etc.
- 3.2 Different initiating systems such as free radical polymerization, redox, cationic & anionic polymerization (different terms such as living polymers, inifers, telechelics).
- 3.3 Their kinetics & control over structure of polymer.
- 3.4 Condensation polymerization, different catalysts used case studies of condensation polymerization, Carothers equation, Comparison of these systems with advantages & disadvantages.
- 3.5 Copolymerization, reactivity ratios & kinetics of copolymerization (copolymer composition equation).

- 3.6 Rheological concepts of polymer solutions and melts, degradation plasticization Mixing operations: Typical agitation system, dissolution
- 3.7 Different advanced catalyst systems: Ziegler Natta catalyst & metallocene catalysts & their role in polyolefins, ATRP etc.

**Reference Books:**

1. Raw Materials for Industrial Polymers by H Ulrich, Hanser Publication 1989.
2. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.
3. Principles of Polymer Science, Bahadur and Sastry, Narosa Publishing House 2002.
4. Polymer Science, Gowariker, John Wiley and Sons 1986.
5. Polymer Science, Gowariker, John Wiley and Sons 1986.
6. Encyclopedia of Polymer Science and Technology, John Wiley and Sons, Inc 1965

