



POLYMER REACTION ENGINEERING

PROF. SHISHIR SINHA

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IIT Roorkee

TYPE OF COURSE : Rerun | Core | UG/PG

COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE : 23 Apr 2022

INTENDED AUDIENCE : Chemical engineering, polymer engineering, polymer technology, mechanical engineering

INDUSTRIES APPLICABLE TO : Useful for all polymer industries and companies related to surface and interfacial technology such as plastic, paints, rubber, resin, adhesive, and advanced polymeric material industries.

COURSE OUTLINE :

The course provide a complete overview of current and future aspects in polymer engineering. The finished polymer product properties are usually determined during the production process and hence it very essential to understand all the fundamentals and chemistry behind the polymerization process. Various terms such as reaction initiation, propagation, termination, reaction kinetics, thermal kinetics, molecular weight, and physical features such as microstructures, morphology, tensile and fractural strength etc. will be discussed in this course. The general polymerization concepts, principles, kinetics and methodology will be discussed through various examples. The course will be helpful for polymer and chemical engineer, students and industries for the advancement in the concepts related to polymer reaction engineering.

ABOUT INSTRUCTOR :

Prof. Shishir Sinha is presently working as Professor and Head in the Department of Chemical Engineering at IIT Roorkee. His research interests are in the areas related to Membrane Separation, Water Treatment, Polymer Synthesis and Modification, Ion Exchangers, Composites. Dr. Sinha has published more than 100 papers in world class esteemed international journals with very high impact factors. Apart from this he has written nine books and several book chapters. He has handled various research and consultancy projects having outlay more than 16 Crores. Particularly in the area of polymers, he had supervised more than 12 Ph.D. and several M.Tech. and B.Tech students. He has a teaching experience in chemical engineering of more than 20 Years.

COURSE PLAN :

Week 1: Introduction to polymerization process: classification of polymers, Short history, monomer and its distribution, Polymer and its composition, Isomerism in polymers

Week 2: Bonding forces in polymers, Molecular weight and its distribution, control of polymer synthesis; thermodynamic and kinetic control, diffusion control, polymer end chain control & polymerization process

Week 3: Morphology of polymers, Introduction to reactor design, Interpretation of batch reactor data; Rate equations, Kinetic equations for unimolecular irreversible different order reaction such as Zero order, first order

Week 4: Interpretation of batch reactor data; Kinetic equations for unimolecular & bimolecular irreversible different order reaction such as second order & nth order, Half -life, varying and constant volume reaction system

Week 5: Recycle reactor, Auto catalytic reactions, Design for multiple reactions: Parallel and series reactions, quantitative and qualitative treatment of product distribution and of reactor size for different types of ideal reactors

Week 6: Problems; related to reaction kinetics, series and parallel reaction and multiple reactor systems, Reaction engineering of step growth polymerization: Basic properties & Examples of commercially important polymers

Week 7: Step growth polymerization; Molecular weight control in linear polymerization, Molecular weight distribution in linear & non-linear polymerization, Introduction to radical chain polymerization

Week 8: Radical chain polymerization; Rate Expression, Cage Efficiency, Determination of Rate of polymerization

Week 9: Redox Initiation (cont.), Initiation in non-aqueous media, Rate of Redox polymerization, Photochemical Initiation

Week 10: Heterogenous Polymerization: Precipitation, Suspension (cont.) & Emulsion Polymerization; microstructural feature, factors affecting the emulsion polymerization, process of emulsion polymerization

Week 11: Heterogenous Polymerization: Precipitation, Suspension (cont.) & Emulsion Polymerization; microstructural feature, factors affecting the emulsion polymerization, process of emulsion polymerization

Week 12: Ionic Chain Polymerization: classification of ionic species, effect of solvents, conductance studies, initiation and propagation in ionic polymerization, effect of solvating agent, Heat and Entropy of dissociation of ionic pairs