

# Polymer Reaction Engineering

## Course Overview

This detailed course covers the essentials of industrial polymer reaction engineering. Your learning will focus on:

- a review of polymerization mechanisms and kinetics
- polymer reactor design, including batch and continuous reactors and the polymerizations typical of each
- design issues affecting MWD
- reactor analysis and modeling, including flow patterns, residence times, and transport equations

Participants encouraged to bring polymerization development and process problems you have encountered for discussion at the course. This is your opportunity to discuss and explore innovative and practical solutions to your application requirements. The course notes that accompany the lectures will serve as a valuable reference for you back on the job.

## The Benefits

At the end of the course participants will understand:

- about polymer mechanisms and kinetics
- how reactor geometry and mode affect polymer properties
- how polymer processes are developed, scaled, and optimized
- how polymers are recovered, purified, and modified
- about the critical parameters of polymer reaction engineering: stoichiometry, equilibrium, heat removal, viscosity
- about process models available to help you evaluate design alternatives and process modifications

## Who Should Attend

This course is designed for Process Engineers and Chemists, Production Engineers, Plant Engineers, Managers, Supervisors, Start-Up And Operating Engineers and personnel, R&D Engineers and Chemists, Plant Laboratory Supervisors, Applications Engineers, Pilot Plant Managers and Maintenance Engineers.

Project design engineers and analytical personnel will also benefit from this course.

## Course Outline

### ◆ Introduction.

- A review of Polymer Types
- Development in Polymerization Engineering

### ◆ Polymerization Mechanisms

- Basic Principles for Polymerization Reactions
- Condensation or step growth
  - binary polycondensations
  - stoichiometry
  - self-condensations
  - equilibrium limitations
  - solubility considerations
  - cyclization
- Addition or chain growth
  - chain structures
  - mechanisms
  - microstructure
  - catalyst types
  - anionic
  - cationic
  - Ziegler-Natta catalysis
  - metallocene catalysis
  - group transfer

### ◆ Polymerization Kinetics

- Kinetic steps
  - initiation
  - propagation
  - termination
  - chain transfer
  - branching and cross-linking
  - moments of the MWD
  - mixing rules for MWD

### ◆ Molecular Weight Distributions (MWD)

- Measurement techniques
- Effects on physical properties
- Mathematical solutions
- Means and moments
- Distributions by number
- Distributions by weight

### ◆ Kinetics and MWD in Ideal Reactors

- Batch polycondensations
- Batch anionic polymerizations
- Batch free radical polymerizations
- Homogeneous CSTRs
- The “Gel Effect”

### ◆ Copolymerizations

- Copolymer composition equation
- Reactivity ratios
  - macroscopic composition distributions
  - microscopic composition distributions
  - combined distributions
  - copolymer azeotropes

◆ Industrial Polymerization Reactors

- Reactor classifications
  - operating mode
  - reaction phases
  - reactor geometry
- Key design issues
  - stoichiometry
  - equilibrium limitations
  - heats of reaction
  - heat removal
  - viscosity
- Temperature Controlling
- Pressure Controlling
- Solvent Overflow
- Design considerations for random copolymers
- Polymerizations with a suspending phase
  - suspension
  - dispersion
  - emulsion
- Monitoring, dynamics and control of polymerization reactors

◆ Reactor Scale-up

- Limits
- Factors
- Stirred tank reactor scale-up
- Tubular reactor scale-up

◆ Polymer Purification, Finishing, and Modification

- Devolatilization history
- Polymer purification tools
- Milling devolatilization
  - co-rotating twin screw extruders
  - counter-rotating twin screw extruders
  - single screw extruders
  - wiped film evaporators
- Flash devolatilization
  - back-venting
  - natural foaming
  - induced foaming
- Polymer washing and clean-up
- Blending and compounding
  - polymerization blending
  - solution blending
  - blend morphologies
  - interfacial agents

◆ Problems Solving Techniques.

◆ Case Studies.

◆ Future Prospects.

**For any further information please contact us at:**

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