Emulsion Polymers Consulting and Education, LLC presents

*Scale-up and Commercial Production of Emulsion Polymers**

NASA photo - Earth rising over the Moon's horizon. Photo from Apollo 11 spacecraft

An On-line, Interactive Workshop October 18-20 and 25-27, 2021

Faculty
Donald C. Sundberg, PhD
Michael F. Cunningham, PhD

* Emulsion Polymers Consulting and Education (EPCEd) has a curriculum of 9 interactive workshops under the umbrella of the Science and Technology of Emulsion Polymers, or STEP^{n}. This workshop is STEP^{8}.

WORKSHOP OBJECTIVES: Provide industrial engineers and scientists with an ***intensive, interactive*** workshop on the production of synthetic latexes in pilot and commercial scale reactors. Transition from laboratory scale operations to the pilot and commercial scales involves new considerations of mixing, feed streams, reactor operating mode (batch, semi-batch, continuous), heat transfer and finishing operations. Beginning with a review of the fundamental aspects of emulsion polymerization, the focus then turns to the details of process alternatives for producing co- and terpolymer latexes at high solids content. The participants work through case studies in which they have to confront choices of monomer (neat or emulsion) feed streams, reactor temperature profiles, surfactant and initiator streams, and reducing residual monomers to acceptable levels. Reactor heat removal and mixing considerations become key features in reaching practical conditions for successful production in large reactors.

INTENDED AUDIENCE: This workshop is particularly directed towards those in industry who are responsible for moving latex polymerization processes from the lab to the commercial scale, including those responsible for process safety. Laboratory scientists will also benefit by learning to appreciate the special features of large scale reactors that help to define process possibilities and economics.

STRUCTURE OF THE WORKSHOP: This on-line workshop will be presented in one, ***4-hour segment*** on each of the six days in October. Daily starting times are planned to be at 9:30 AM (EDT). Sessions will be conducted in an ***interactive manner*** with participants engaged in problem solving and facilitated discussions. On-line sessions will be conducted via Microsoft Teams.

WORKSHOP OUTLINE: See next page for a complete schedule of topics. Faculty profiles follow on page 4.

REGISTRATION INFORMATION

The registration fee includes the full book of slides for the workshop. Early registration is recommended due to the workshop size limitation of 24 participants.

Registration Fee: $1800 USD
Registration Form – Click here

Contact for further information:
info@epced.com

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Session 1

- Basics of creating and characterizing synthetic latices
  1. Particle nucleation and growth
  2. Control of particle size distribution
  3. Control of copolymer composition, MW, gel content
  4. Functional additives (esp. vinyl acids) and neutralization
  5. Colloidal stability
  6. Latex rheology, especially at high solids content
  7. Measurement of particle size, chemical composition, glass transitions, MFFT, acid distribution

Session 2

- Reaction process alternatives
  1. Batch reactors
     - *Ab initio* particle nucleation (I), growth (II) and final (III) periods
     - "Seeded" polymerizations
     - Copolymer composition drift, surfactant and initiator demands
     - Heat evolution profiles and heat transfer requirements
  2. Semi-batch reactors
     - Comonomer feed strategies (constant/variable rates, power feeds)
     - Effective monomer concentration in particles
     - Surfactant and initiator demands
     - Heat transfer requirements
  3. Continuous reactors
     - Residence time considerations
     - Number and size of reactors in series
  4. Temperature control characteristics of reactors
     - Jacketed reactors, cooling water limitations
     - Reflux operations, vapor velocity
     - Cooling capacity of monomer/emulsion feed streams

Session 3

- Concepts and issues of scale up
  1. Comparisons of small and large reactors
     - Surface to volume ratio
     - Radial and vertical mixing
     - Potential for temperature and concentration gradients
  2. Dynamic similarity considerations of reactors
  3. Issues related to process type (batch, flooded, starve fed)
     - Reaction rate/time profiles, heat evolution
     - Free monomer content within reactor and vapor pressure
     - Phase distribution of functional monomers
     - Reactor entry point for monomer/emulsion feed stream

Session 4

- Fluid mixing characteristics and issues in large reactors
  1. Agitator types and purposes, tip speeds
  2. Fluid behavior near agitator blades
  3. Velocity distributions within the reactor
     - Effect on dispersing incoming monomers
     - Effect on energy transport to reactor walls
     - Computational fluid dynamics (CFD)
- Positioning feed stream entry points
- Agitator power requirements during reaction

Session 5

- High solids latex production
  1. Optimization of polymer production capacity
  2. Latex viscosity and heat transfer
  3. Optimal particle size distribution
  4. Post-reaction neutralization of vinyl acid functional additives
     - Maximum concentration of base
     - Feed rate of base addition

Session 6

- Residual monomer reduction – chemical and physical alternatives
- Avoiding secondary nucleation, particle aggregation and coagulum in scale-up
- Sensors for off/on-line measurements - latex surface tension and conductivity
- Scale-up criteria – what works best for different types of latices
- Identifying potential "show stoppers" or critical issues in a polymerization process
- Concepts in process ***scale-down***
    1. Designing lab and pilot scale experiments to investigate problems encountered in commercial scale operations
    2. Identifying potential large scale problems while still at the small scale
- Problem solving
- Conclusion of workshop

Faculty Profiles

Professor Donald C. Sundberg has been working in the field of emulsion polymers for 53 years. He received a bachelor's degree in chemical engineering from Worcester Polytechnic Institute (Massachusetts) and his Ph.D. from the University of Delaware. He worked on latex based impact modifiers for ABS resins with the Monsanto Company, scaling processes to the 10,000 gallon reactor size. He has extensive research experience in emulsion polymerization and is widely recognized for his work on structured latex particles. This has resulted in over 100 peer reviewed publications and many conference papers. In addition he has conducted many workshops, most notably the one on latex particle morphology control. He spent a sabbatical year at the Institute for Surface Chemistry in Stockholm and was Chair of the 1997 Gordon Research Conference on Polymer Colloids. He is the 2016 Mattiello Memorial Lecture awardee from the American Coatings Association. His research interests are in polymerization kinetics in solution, bulk and emulsion systems, interfacial science and polymer morphology control, diffusion in polymers, and coatings. He is an Emeritus Professor of Materials Science at the University of New Hampshire and is the founder of Emulsion Polymers Consulting and Education, LLC.

Professor Michael F. Cunningham has an extensive background in dispersed phase polymerizations, including suspension, emulsion, miniemulsion and dispersion polymerization. He received a bachelor's degree in Engineering Chemistry from Queen's University (Kingston, Ontario, Canada) and his Ph.D. from the University of Waterloo. He spent six years working on dispersed phase polymerizations in the Xerox Corporate Research Group, acquiring experience in process scaleup and technology transfer to manufacturing. He has an active research program in polymer colloids and emulsion polymerization, particularly in the area of living radical polymerization and stimuli-responsive particles, publishing over 200 peer reviewed publications, and holding 26 U.S. patents. He is secretariat of the International Polymer Colloids Group, and previously held the Ontario Research Chair in Green Chemistry and Engineering. He has consulted with a number of companies in the area of emulsion and suspension polymerization, and lectured for over 10 years at industrial short courses on emulsion polymerization in the USA and Switzerland. He is a Partner with Professor Sundberg in the international consulting firm Emulsion Polymers Consulting and Education, LLC.

Scale-up and Commercial Production of Emulsion Polymers

On-line workshop

October 18-20 and 25-27, 2021

Registration Form

Name_____
Address_____
_____
City/State_____
Postal Code_____
Country_____
Position or Title_____
Organization_____
Phone_____
Fax_____
E-mail_____

Participant Category

- ☐ Standard price for industrial participant: $1800 (USD)
- ☐ Discounted price for additional participant(s) from the same company: $1700 (USD)
- ☐ Academic participant: $1600 (USD)

There is a non-refundable fee of $50 (USD). Cancellation of registration can be made up until September 20, 2021 with a full refund less the $50 processing fee.

Method of Payment:

- ☐ Credit Card

___Visa ___MasterCard ___American Express
Card #_____
Visa or MC Security Code # (last 3 digits on back of card)_____
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- ☐ Wire transfer from bank --- Please go to info@epced.com and request banking instructions.

This registration can be sent as an attachment to info@epced.com. For a more secure eCommerce transaction, call 1-603-742-3370.

This registration form may serve as an invoice for those who register.