



Emulsion Polymers Consulting and Education, LLC presents

## *Characterization of Synthetic Latices \**



**A 3 Day Interactive Workshop**  
**November 13-15, 2017**  
**MicroTek**  
**Orlando, Florida, USA**

**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 STEPn. This workshop is STEP2.

**WORKSHOP OBJECTIVES:** This workshop is focused on the generation and evaluation of data obtained from the various analytical methods used to measure the chemical, physical, colloidal and morphological properties of polymer latices. Latex synthesis professionals will gain insight to the range of analytical techniques and instruments used to measure a wide variety of latex and particle properties; analytical laboratory professionals will gain insight as to how organic, physical and colloid chemistry combine to create latices of commercial complexity. Both communities will learn to deal with the realities of data precision and reproducibility, and comparison between different measuring techniques for the same property. Significant discussion is focused on developing complementary sets of data that allow the full characterization of the latex with confidence.

**INTENDED AUDIENCE:** This workshop has been designed to be of value to both analytical chemists, who measure the properties of synthetic latices, and to the chemists and engineers who make such latices. The combined community will find the cross-fertilization of ideas to be of great value in their collective roles in moving product development forward and to establishing more insightful quality control data sets. Effective communication between scientists and engineers who synthesize the latices and analytical professionals responsible for latex analyses will be enhanced by appreciation of the capabilities and limitations of each analytical technique, specific to the context of polymer colloids.

**STRUCTURE OF THE WORKSHOP:** This 3-day workshop will be conducted in a *highly interactive manner* with participants engaged in problem solving (e.g. spectral, TEM image and thermal transition data analyses), discussions and demonstrations.

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

### **REGISTRATION INFORMATION**

The registration fee includes the full book of slides for the workshop, coffee breaks, and Tuesday evening dinner. It does not include lunches, lodging or travel. ***Early registration is recommended*** due to the workshop size limitation of 24 participants.

Registration Fee: \$1700 USD  
Registration Form – [Go To Page 5](#)

***Contact for further information:***  
[info@epced.com](mailto:info@epced.com)

## *Characterization of Synthetic Latices – Physical, Chemical, Colloidal and Morphological Properties*

### Day 1

AM

- **What does it mean to “fully” characterize a latex?**
- **Basics of creating 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. Residual monomer reduction
- **Latex applications**
  1. Coatings (architectural, paper, adhesive, textile)
  2. Thermoplastic impact modifiers
  3. Printing inks
  4. Cement and asphalt modifiers
- **Physical and colloidal properties of latices**
  1. Particle size distributions – techniques, comparisons, limitations. Homo- and copolymers. Multi-phase particles. Mono- and bimodal latices
  2. Problem solving

PM

- **Physical and colloidal properties of latices**
  1. Particle shape – SEM, TEM, AFM
  2. Particle density – monomer type, water content, composite particles
  3. Surfactant adsorption and coverage, CMC
  4. DLVO theory – charge interactions, non-ionic surfactants, titration procedures
  5. Competitive adsorption between ionic and non-ionic surfactants
  5. Electrophoresis – Zeta potential
  6. Colloidal stability (CCC, Maron, Waring blender)
  7. Establishing surfactant adsorption isotherms

### Day 2

AM

- **Glass transitions,  $T_g$** 
  1. Dynamic mechanical analysis (DMA)
  2. Differential scanning calorimetry (DSC)
  3. Homo- and copolymers – characteristic shapes of transitions through the glass point
  4. Flory-Fox, Ponchon, Gordon-Taylor equations
  5. “Wet”  $T_g$ . Measurements and contrast with “dry”  $T_g$ . Water and organics as plasticizers.
- **Minimum film formation temperature (MFFT)**
  1. Instrumentation and operating conditions
  2. Reading the boundary
  3. Relationships between MFFT and  $T_g$ .
- **Latex viscosity**
  1. Rheometers – simple, sophisticated
  2. Real and “apparent” viscosities
  3. Newtonian and shear thinning viscosity
  4. Which viscosity is important?

PM

- **Chemical Properties**
  1. Overall polymer chemistry –
    - a.) Composition – average and distribution, NMR, FTIR
    - b.) MW – average and distribution, viscometry, GPC
    - c.) Orthogonal chromatography for CCD and MWD
  2. “Regional” chemistry
    - a.) Surface chemistry – surfactant adsorption, initiator end groups
    - b.) Functional monomers (e.g. AA– distribution in serum and in/on particles (titration techniques)

- 3. Branching and crosslinking
  - a.) Sol – solvent extractions, characterization of sol polymer
  - b.) Gel – solvent swelling index NMR (solid state) for branch points
  - c.) DMA of films
- 4. Grafting
  - a.) Selective extraction, – grafting efficiency, number of graft sites
  - b.) Solid state NMR
  - c.) MWD of sol (GPC),
- 5. Residual monomer content – GC, HPLC
- **Serum phase characterization**
  - a.) Separation of serum phase by centrifugation or filtration
  - b.) Serum replacement techniques
  - c.) Water soluble polymer (overall overall MW)
  - d.) Individual chain identification – liquid chromatography, mass spectroscopy

### Day 3

#### AM

- **Structured Particles – Morphology**
  - 1.) General considerations – what details are we looking for?
  - 2.) External shape - SEM, AFM, soft and hard particles, surface chemistry
  - 3.) Internal structure
    - a.) Phase separation within particle – thermodynamics, kinetics
    - b.) Extent of phase separation – quantitative assessment via DSC, DMA – qualitative assessment via TEM
    - c.) Polymer-polymer interfaces within particles
    - d.) Comparisons between “as is” and thermally annealed samples
    - e.) Polymer-polymer de-mixing within particles
  - 4.) Problem solving

#### PM

- **Structured Particles - Morphology**
  - 5.) Location of the polymer phases within the particle
    - a.) AFM (height and phase modes)
    - b.) TEM (**whole particle**) – staining for phase contrast, soft particles, particle edge effects, false positives
    - c.) TEM (**sectioned**) – embedding resins (epoxy, latex), sectioning, chemical staining (e.g. Os, Ru, PTA)
    - d.) Minimum domain sizes, interfacial regions, phase ratio constraints, false positives
  - 6.) TEM – EELS techniques
  - 7.) STXM – X-ray microscopy
  - 8.) The need for “complementary” data sets
  - 9.) Problem solving
- **Review of important concepts**
- **Open discussion of questions from participants**

## **Faculty Profiles**

**Professor Donald C. Sundberg** has been working in the field of emulsion polymers for 50 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 nearly 100 peer reviewed publications and many conference papers. In addition he has conducted many workshops, most notably the one on latex particle morphology control, now in its 22<sup>nd</sup> annual offering. 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 chemical engineering from Queen's University (Kingston, Ontario) 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, publishing over 100 papers and holding 26 U.S. patents. He is secretariat of the International Polymer Colloids Group, and holds an Ontario Research Chair in Green Chemistry and Engineering. He has consulted with several companies in the area of emulsion and suspension polymerization, and lectured for ten years at industrial short courses on emulsion polymerization in the USA and Switzerland.

## ***Characterization of Synthetic Latices***

MicroTek Orlando Training & Meeting Rooms

### **Registration Form**

Orlando, Florida, USA

November 13-15, 2017

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_

Postal Code \_\_\_\_\_

Country \_\_\_\_\_

Position or Title \_\_\_\_\_

Organization \_\_\_\_\_

Phone \_\_\_\_\_

Fax \_\_\_\_\_

E-mail \_\_\_\_\_

#### **Participant Category**

- Standard price for industrial participant: \$1700 (USD)
- Discounted price for additional participant(s) from the same company: \$1600 (USD)
- Academic participant: \$1300 (USD)

***There is a non-refundable fee of \$50 (USD). Cancellation of registration can be made up until October 13, 2017 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) \_\_\_\_\_

AMEX Security Code # (4 digits on front of card) \_\_\_\_\_

Expiration date \_\_\_\_\_

Signature \_\_\_\_\_

Credit Card billing address (if different than above):  
\_\_\_\_\_  
\_\_\_\_\_

Wire transfer from bank --- Please go to [info@epced.com](mailto:info@epced.com) and request banking instructions.

***This registration can be sent as an attachment to [info@epced.com](mailto:info@epced.com). For a secure eCommerce transaction, FAX this completed form to EPCEd at 1-603-343-4015, or call 1-603-742-3370. This registration form may serve as an invoice for those who register.***