Emulsion Polymers Consulting and Education, LLC presents

*Characterization of Synthetic Latexes**

A 3 Day Interactive Workshop
October 1-3, 2018
MicroTek - Denver
Denver, Colorado, 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: Accurate and reliable interpretation of the physical, chemical and morphological property measurements of emulsion polymers is a critical part of product development and quality control. However, correctly interpreting characterization data for latexes is complex and often ambiguous. This workshop is focused on the generation, evaluation and interpretation of data obtained from the various analytical methods used to measure the chemical, physical, colloidal and morphological properties of polymer latexes. 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 latexes 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.

INTENDED AUDIENCE: This workshop has been designed to be of value to both analytical chemists, who measure the properties of synthetic latexes, and to the chemists and engineers who make such latexes. 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.

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

Characterization of Synthetic Latexes– Physical, Chemical, Colloidal and Morphological Properties

Day 1

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- **What does it mean to "fully" characterize a latex?**
- **Basics of creating synthetic latexes**
  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 latexes**
  1. Particle size distributions – techniques, comparisons, limitations. Homo- and copolymers. Multi-phase particles. Mono- and bimodal latexes
  2. Problem solving

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- **Physical and colloidal properties of latexes**
  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

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- **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?

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- **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

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- **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 51 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 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 22nd 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 and president 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 and stimuli-responsive particles, publishing over 180 papers and holding 26 U.S. patents. He is secretariat of the International Polymer Colloids Group. 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.

Registration Form for *Characterization of Synthetic Latices*

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October 1-3, 2018

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 September 1, 2018 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):
_____
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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 e-mail attachment to info@epced.com. If you prefer not to e-mail your credit information, submit this form without it and call 1-603-742-3370 to complete your registration. ***This registration form may serve as an invoice for those who register.***