Emulsion Polymers Consulting and Education, LLC present:

Hybrid Latex Systems-
PU, Alkyd and Inorganic/Acrylic Latices

3 Day Interactive Workshop
April 18-20, 2016
Mary Gates Learning Center
Alexandria, Virginia, USA

<u>Faculty</u>
Donald C. Sundberg, PhD
John G. Tsavalas, PhD
W. Marshall Ming, PhD

<u>WORKSHOP OBJECTIVES:</u> This workshop is designed to provide industrial scientists and engineers with an intensive, interactive workshop on the synthesis and use of several types of hybrid latices. Among these are *alkyd/acrylic, polyurethane acrylic* and *inorganic/organic* polymer latices. The similarities to, and differences from, standard latex polymerizations are presented in great detail so that the participant has the opportunity to grasp the fundamental aspects of the polymerization reactions and colloid chemistry associated with making such morphologically interesting particles. The alkyd, polyurethane and inorganic dispersions required as a first step in the production of hybrid latices usually require special techniques and these will be reviewed as part of the workshop.

<u>INTENDED AUDIENCE:</u> We have designed this workshop for industrial scientists and engineers who have some background in "standard" emulsion polymerization techniques, and who are interested/engaged in extending their experience to include the synthesis, characterization and use of hybrid latices.

<u>STRUCTURE OF THE WORKSHOP:</u> This 3-day workshop will be conducted in a ***highly interactive manner*** with participants engaged in discussions, demonstrations, and problem solving.

<u>REGISTRATION INFORMATION</u>

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

Registration Fee: $1650 USD
Registration Form --> Go to page 5

Contact for further information:
info@epced.com

Hybrid Latex Systems – PU/Acrylic, Alkyd/Acrylic and Inorganic/Organic Latices

Day 1

AM:

- Basics of emulsion polymerization
- Particle size control
  Copolymer composition control
- Colloidal stability
- Structured latex particles
- Characterization of latices and other dispersions
- Introduction to latex film formation

PM: **Organic/inorganic hybrid particles**

- Why incorporate inorganics into latex particles?
- Morphological control (thermodynamic vs. kinetic)
- Introduction to Pickering Emulsions
- Making organic/inorganic hybrid particles
  - Emulsion polymerization
  - Mini-emulsion polymerization
  - Dispersion polymerization
  - Heterocoagulation

- Various organic/inorganic hybrid particles
  - Polymer/silica hybrid particles
    - ✓ Core-shell particles
    - ✓ Pickering stabilization
- Polymer/clay hybrid particle
    - ✓ Clay encapsulation
    - ✓ Clay-armored latex particles
- Polymer/CNT hybrid particles
- Magnetic hybrid particles

Day 2

AM: **Organic/inorganic hybrid particles, continued**

- Other organic/inorganic hybrid particles
    - ✓ Stimuli-responsive organic/inorganic hybrid particles
    - ✓ Polymer/metal hybrid particles
- Film formation of organic/inorganic hybrid particles
- Properties of coatings from organic/inorganic hybrid particles

Day 2

Alkyd/Acrylic Latex Particles

- What is an alkyd/acrylic hybrid? How is it different than other polymer/polymer hybrids?
- Incentives for an alkyd/acrylic hybrid latex
  - synergy of properties from solvent borne and waterborne coating systems
  - no VOC
- Brief background of solvent borne alkyd coatings
- Alkyds: chemistry, structures, fatty acid constituents, double bond content & degree of unsaturation

- ***Alkyd/Acrylic Latex***
  - Hydrophobicity of alkyd precludes its use in traditional emulsion polymerization
  - Miniemulsion polymerization
    - applicability to this system and typical procedures

PM: **Alkyd/Acrylic Hybrid Latex**

- Hybrid particle morphology
  - Target morphologies
  - Thermodynamic vs. kinetic control
  - Characterization
  - Challenges/constraints
- Grafting of alkyd & acrylic phases
  - Mechanisms
  - Characterization
  - Implications
- Kinetics of Acrylic Polymerization in Presence of Alkyd
    - Retardation
      - ✓ Function of type of alkyd used
    - Limiting monomer conversion
      - ✓ What is this? What levels of unreacted monomer?
      - ✓ Theories as to why this occurs in this type of system
      - ✓ Methods to overcome and finish the residual monomer

Day 3

AM: **Alkyd/Acrylic Hybrid Latex, continued**

- Film formation of alkyd/acrylic latex
    - Auto-oxidative cross linking of alkyd residual double bonds with drying oils
    - No drying oil added
- Properties of alkyd/acrylic latex films

Polyurethane/Acrylic Hybrid Latex Particles

- ***Aqueous polyurethane dispersions***

- VOC driving force
- Types of PU's that are useful as PUD's
- Creating PUD's
    - Chemistry, stabilization

  Dispersion process, particle size control
    - Use of NMP and other solvents
    - Hydrogen bonding, hard segment nano-domains
    - Water content in PU particles
- Film applications
- Coating properties

Day 3

- ***PU/Ac hybrid latex particles***

- Driving force for PU/Ac latex
- Types of acrylics of interest
- Morphological alternatives
    - Thermodynamic control
    - Kinetic control

PM: **Polyurethane/Acrylic Hybrid Latex Particles, continued**

- Polymerization processes
    - PUD as "seed" particles, pH control
    - Batch and semi-batch acrylic polymerization
    - Grafting to PU backbone
    - Reaction kinetics, including starve fed
        - ✓ Initiator systems
        - ✓ Reaction temperature ranges
        - ✓ Simultaneous condensation polymerization of urethane and free radical polymerization of acrylic
    - Establishing phase structure in PU/Ac composite particles
    - Effect of annealing
    - Hydrogen bonding issues
- Properties of composite films
    - PUD – Ac latex blends
    - PU/Ac composites

Faculty Profiles

Professor Donald C. Sundberg has been working in the field of emulsion polymers for 49 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 spent 5 years working on impact modifiers for ABS resins with the Monsanto Company prior to pursuing a career in the university setting. 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 he has presented many conference papers. He spent a sabbatical year at the Institute for Surface Chemistry in Stockholm and was Chair of the Gordon Research Conference on Polymer Colloids. He maintains active research interests in emulsion polymerization kinetics, interfacial science and polymer morphology control, diffusion in polymers, microencapsulation, 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 John G. Tsavalas is an Associate Professor of Chemistry at the University of New Hampshire, the director of the Nanostructured Polymers Research Center, and the deputy director of an interdisciplinary multi-department research center at UNH centered around Advanced Materials (CAMMI). He received his PhD in Chemical Engineering from The Georgia Institute of Technology (Atlanta, GA, USA) after which he was a Senior Research Scientist in The Dow Chemical Company (Midland, MI USA). In industry he worked on a wide variety of polymer colloid related R&D with particular emphasis on nanostructured latex particles. At the University of New Hampshire, Professor Tsavalas' current active areas of research are colloidal nanostructure morphology development, sustainably derived polymer colloids, the interaction and distribution of water in polymer colloids, and dynamic modeling of interactions, kinetics, diffusion, and phase separation in colloidal systems

Professor W. Marshall Ming is the Distinguished Chair in Materials Science and a Full Professor in Chemistry at Georgia Southern University. He earned his PhD in Polymer Chemistry and Physics from Fudan University in Shanghai in 1998, and a B.S. in Materials Chemistry from the same school in 1993. Dr. Ming's primary research has focused on multifunctional, nanostructured polymer materials and coatings, including super-repellent coatings, antimicrobial coatings, antibioadhesion coatings, antifogging/frost-resisting coatings, smart coatings for metal corrosion detection and preemptive protection, self-healing polymers, and polymer hybrid composites. He received a First-place Roon Award from American Coatings Association in 2012.

Registration Form

Hybrid Latex Systems
Alexandria, VA 22314, USA
April 18-20, 2016

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

Participant Category
□ Standard price for industrial participant: $1650 (USD)
□ Discounted price for additional participant(s) from the same company: $1550 (USD)
□ Academic participant: $1200 (USD)

There is a non-refundable fee of $50 (USD). Cancellation of registration can be made up until March 18, 2016 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 --- Go to info@epced.com and request banking instructions. **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.