Emulsion Polymers Consulting and Education, LLC present:

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

2 Day Interactive Workshop
April 28-29, 2014
On the Campus of the University of New Hampshire
Durham, New Hampshire USA

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

<u>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 2-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, lunches and Monday evening dinner. It does not include accommodations or travel. Early registration is recommended due to the workshop size limitation of 24 participants.

Registration Fee: $1250 USD
Registration Form --> Go to page 4

Contact for further information:
info@epced.com

<u>HOTELS, TRAVEL, LOCAL ATTRACTIONS</u>

Hotels in the local area are listed on the last page. Each has a link to its website for on-line reservations. The Durham, NH area is well served by Logan Airport in Boston, Massachusetts and Manchester Airport in Manchester, NH. Durham is located in the seacoast region of New Hampshire and many tourist options are available. www.visitnh.gov/. Also see the UNH website www.unh.edu.

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
- Dispersion rheology
- Mini-emulsion polymerization techniques
- Introduction to Pickering Emulsions
- Characterization of latices and other dispersions

PM: **Organic/inorganic hybrid particles**

- Why incorporate inorganics into latex particles?
- Morphological control (thermodynamic vs. kinetic)
- 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
- 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

AM: **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 Hybrid Latex**
  - Hydrophobicity of alkyd precludes its use in traditional emulsion polymerization
  - Miniemulsion polymerization
    - applicability to this system and typical procedures
- 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
- 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

PM: **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

- **PU/Ac hybrid latex particles**

- Driving force
- Types of acrylics of interest
- Morphological alternatives
  - Thermodynamic control'
  - Kinetic control
- Polymerization processes
  - PUD as "seed" particles, pH control
  - Batch and semi-batch acrylic polymerization
  - Reaction kinetics, including starve fed
    - ✓ Initiator systems
    - ✓ Reaction temperature ranges
  - 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 46 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 a Research Assistant Professor in the Nanostructured Polymers Research Center and the Materials Science Program at UNH. He came to UNH after 5 years as Senior Research Scientist in Dow Latex R&D at Dow Chemical in Midland, Michigan. There he worked on a wide variety of latex product and process development with particular emphasis on structured latex particles. He holds a B.S. in Chemical Engineering from the University of Virginia and both the M.S. and PhD in Chemical Engineering from Georgia Tech. His active areas of research are structured latex particles, micro– and nano-encapsulation, hybrid/acrylic latices, smart multi-functional coatings, diffusion and phase separation in reactive polymer systems.

Professor W. Marshall Ming is the Distinguished Chair in Materials Science and an Associate 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 antimicrobial coatings, smart coatings for corrosion detection and prevention, and anisotropic particles/polymer hybrid composites. He received a First-place Roon Award from American Coatings Association in 2012, and is currently an editorial board member for Journal of Adhesion Science and Technology.

Registration Form

Hybrid Latex Systems

Durham, NH 03824 USA
April 28-29, 2014

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

Participant Category

□ Standard price for industrial participant: $1250 (USD)
□ Discounted price for additional participant(s) from the same company: $1200 (USD)
□ Academic participant: $1100 (USD)

There is a non-refundable fee of $50 (USD). Cancellation of registration can be made up until March 28, 2014 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 --- 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.

LODGING OPTIONS

WALKING DISTANCE TO UNH Conference Site (about 10 min):

Holiday Inn Express
2 Main St., Durham, NH 03824
603-868-1234
www.hiexpress.com

Three Chimneys Inn
17 Newmarket Rd., Durham, NH 03824
603-868-7800
www.threechimneysinn.com

REQUIRES A VEHICLE:

Comfort Inn & Suites
10 Hotel Dr, Dover, NH 03820
603-750-7507
www.comfortinn.com

Dover Days Inn Durham/Downtown
481 Central Ave, Dover, NH 03820
603-742-0400
www.daysinn.com

Microtel Inns & Suites
31 Webb Pl, Dover, NH 03820
603-953-0800
www.microtelinn.com

Silver Fountain Inn
103 Silver St, Dover, NH 03820
603-750-4200 or 888-548-6888
www.silverfountain.com

Hilton Garden Inn
100 High St, Portsmouth, NH 03801
866-413-1105
www.hgiportsmouth.com

Residence Inn Portsmouth Downtown
100 Deer St, Portsmouth, NH 03801
603-968-5095
www.marriott.com

Sheraton Portsmouth Harborside
250 Market St, Portsmouth, NH 03801
603-431-2300
www.sheratonportsmouth.com

Best Western Wynwood Hotel & Suites
580 US Hwy 1 Bypass, Portsmouth, NH 03801
603-436-7600
www.wynwoodportsmouth.com

Residence Inn by Marriott
1 International Dr, Portsmouth, NH 03801
866-430-2692
www.marriott.com

Fairfield Inn by Marriott
650 Borthwick Ave Ext, Portsmouth, NH 03801
603-436-6363 or 800-228-2800
www.marriott.com

Hampton Inn Portsmouth
99 Durgin Lane, Portsmouth, NH 03801
603-431-6111
http://hamptoninn.hilton.com

Holiday Inn
300 Woodbury Ave, Portsmouth, NH 03801
800-315-2621
www.holidayinn.com