Successful Liquid Mixing Scale-up Methods

January 11–13, 2011
Lake Buena Vista, Florida

A course designed specifically for engineers and scientists who must interpret results from laboratory or development-scale tests into large-scale liquid mixing equipment.

- A practical course on the methods used to scale-up liquid mixing processes.
- Learn how to put theory into practice to develop successful industrial mixing processes.
- Explore proven methods for moving liquid mixing processes from lab to pilot plant to production.
- Discover how test methods help determine applicable scale-up criteria.

Save time and money! Inquire about on-site & online courses. Call 800-462-0876 today!

Enroll today to succeed tomorrow.

Please route this brochure to colleagues who would also benefit by attending.
Successful Liquid Mixing Scale-up Methods
January 11–13, 2011, in Lake Buena Vista, Florida

Improve Your Effectiveness
This course is designed to provide you with basic concepts and practical methods to perform laboratory or pilot plant studies for the development of liquid mixing (agitated tank) processes. You will learn strategies for
• creating and conducting a small-scale study
• analyzing and evaluating experimental successes and failures
• applying practical process scale-up methods
The course will address many different process applications in liquid mixing and how to translate results into larger equipment.

Learn How To
• calculate process characteristics important in all mixing applications
• decide which characteristics are most important in your processes
• examine correlations for their accuracy and proper use in experimental studies
• apply methods for scale-up and scale-down to select equipment and operating conditions for experimental studies
• use similarity in processing problems and their solutions
The course will focus on liquid mixing in stirred tanks but may suggest methods for broader application.

Solve Your Scale-Up Problems
Engineers and scientists who conduct experimental mixing studies to develop appropriate data for scale-up will learn the essentials. Process engineers, managers, process chemists, biochemists, and research scientists and engineers in the following industries will benefit by attending:
• chemical, petrochemical, agrichemical, and specialty chemical
• biotechnology, biochemical, and fermentation
• pharmaceuticals and cosmetics
• food processing

This course will be especially valuable to engineers and chemists who are
• new to process development
• setting up experimental mixing equipment
• managing or operating process development projects
• responsible for transitioning projects from the laboratory to development to production
We encourage you to bring process development and translation issues or situations you have encountered for discussion at the course. You will have an opportunity to discuss and explore innovative and practical solutions.

Put Your Learning to Work
This course provides information that you can put to work immediately, including how to
• establish viable process objectives
• use power input to judge the amount of mixing or transport occurring in your process
• judge the results of an experimental study for completeness
• do both geometric and non-geometric scale-up
• assess equipment and operating conditions used for multiphase processing
• determine optimum designs and processing conditions
• scale-up your process between many different sizes
• develop custom scale-up procedures for your specific processes
The material covered during the course assumes basic familiarity with process terms and equipment.

Learn from an Experienced Professional
David S. Dickey, Ph.D. has been an independent consultant since 1998 with Mix-Tech, Inc., in Dayton, Ohio. His experience is unique in the field of mixing and scale-up, since he has had exposure to both the theoretical and practical aspects of real problems and has learned about successes and failures. His experience includes more than 23 years with process equipment manufacturers, where he built pilot plant reactors and systems and spent 16 years working directly with manufacturers of liquid mixing equipment. He has also engineered dry-solids mixing equipment, static mixers, heat exchangers, pumps, distillation, and other process equipment.
He has performed numerous laboratory tests, research investigations, and mixing studies for both specific process applications and general equipment development. That laboratory experience has been translated into many successful large-scale mixers. He holds a B.S. degree in chemical engineering from the University of Illinois and M.S. and Ph.D. degrees in chemical engineering from Purdue University. He has written and/or co-authored more than 30 publications on the practical and technical aspects of scale-up, engineering, equipment, and design.

Please bring a hand-held, engineering calculator capable of doing powers, roots and grouped calculations for your use during the course’s problem solving sessions.

ENROLL ONLINE TODAY! Or visit our Web site
Important Course Topics

Welcome and Introduction
Elaine M. Bower
Program Director
Department of Engineering Professional Development
University of Wisconsin–Madison

Scale-up Objectives
• New products
• Existing processes

Scale-up Concepts
• Objectives of scale-up
• Scale-up and scale-down
• Concept of models
  – physical models
  – mathematical models
• Similarity
• Dimensional analysis
• Scale-up

Principles of Liquid Mixing
• Mixing variables
• Fluid properties
  – density
  – viscosity
• Rheology
• Viscosity measurement
• Turbulent and laminar mixing
• Impeller flow and shear
• Power and torque
• Impeller power
• Power distribution
• Other power contributions
• Pumping capacity
• Blend times
• Flow patterns
• Baffles

Mixing Processes
• Mixing problems
• Liquid-liquid dispersion
• Solids suspension
• Gas dispersion
• Heat transfer
• Mass transfer
• Dry solids addition

General Scale-up
• Geometric similarity
• Subtle geometry changes
• Scale-up ratios
• Fixed ratios, variable results
• Inherent changes
• Non-geometric scale-up
• Measuring scale-up criteria

Specific Scale-up
• Liquid blending
• Surface motion
• Liquid-liquid dispersion
• Solids suspension
• Gas dispersion

Development Studies
• What to study
• How to study
• Mixing procedures
  – batch processes
  – continuous processes
• Value of visual observation
• Dealing with failures
• Improving on success
• Pre-processing
• Post-processing

Process Development Equipment
• Available equipment
• Reactor vessels
• Special features
• Impeller selection
• Mixer drives and motors
• Peripheral equipment
• Basic measurements

Static Mixers
• Types and applications
• Scale-up

Mixing Equipment
• Basic components
• Elements of design
• Practical limitations

Summary

Schedule Note
Registration will begin at 8:00 a.m. on Tuesday, January 11, 2011 at the DoubleTree Guest Suites, in the Walt Disney World Resort. The course will meet from 8:15 a.m. to 4:30 p.m. on Tuesday, from 8:00 a.m. to 4:30 p.m. on Wednesday and from 8:00 a.m. to 3:00 p.m. on Thursday. The daily schedule will include midmorning and midafternoon refreshment breaks and lunch at noon.

Companies Benefiting from this Course
Amgen
Archer Daniels Midland Company
Ashland Inc.
Cargill, Inc.
Chevron-Phillips Chemical
Colgate-Palmolive Company
DuPont
Eastman Chemical
Eli Lilly
Estee Lauder
Goodrich Corporation
Hexion Specialty Chemicals
Illes Seasonings & Flavorings
Johnson & Johnson
Johnson Matthey, Inc.
Mead Johnson Nutritionals
Merck
Nestle USA
Novartis
Nycomed US Inc.
Pfizer
Rich Products Corporation
S.C. Johnson & Sons, Inc.
Sanofi Aventis
The Sherwin Williams Company
Stepan Company
Sun Chemical
Syngenta
Unilever Home and Personal Care
W.R. Grace
Wyeth Consumer Healthcare

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Four Easy Ways to Enroll

Internet:   [http://epd.engr.wisc.edu/webM405](http://epd.engr.wisc.edu/webM405)

Phone:     800-462-0876 or 608-262-1299 (TDD 265-2370)

Mail to:   Engineering Registration
           The Pyle Center, Dept. 107
           702 Langdon Street
           Madison, Wisconsin 53706

Fax:       800-442-4214 or 608-265-3448

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Course Information

- Please enroll me in **Successful Liquid Mixing Scale-up Methods**
  
  **Course #M405** January 11–13, 2011 in Lake Buena Vista, Florida  Fee: $1795
  
  Team Discount: $1650 per person when two or more enroll from the same organization.

- I cannot attend at this time. Please send me brochures on future courses.

Limited Enrollment

Personal Information  (Please print clearly.)

- Name ____________________________
- Title ____________________________
- Company __________________________
- Address __________________________
- City/State/Zip ______________________
- Phone (_______) __________ Fax (_______) __________
- E-mail ____________________________

Additional Enrollees

- Name ____________________________
- Title ____________________________
- E-mail ____________________________

Billing Information

- Bill my company __________
- P.O. or check enclosed (Payable in U.S. funds to UW - Madison)
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- Expire __________
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Successful Liquid Mixing Scale-up Methods

- At a location of your choice
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To inquire about this on-site course or other courses that we can bring to your site, including optimal group size and costs, call 800-462-0876 and ask for Program Director Elaine Bower. Or see [http://epd.engr.wisc.edu/onsite](http://epd.engr.wisc.edu/onsite)

Related Mixing Courses

For information about the following courses, contact Elaine Bower, Program Director, at 800-462-0876 or e-mail her at bowe@engr.wisc.edu

**Advanced Mixing Technology: Practical Applications**

An advanced, yet practical course on the technology and equipment available to solve difficult liquid mixing problems.

**The Art and Science of Industrial Mixing**

A basic course for engineers, scientists and other technical professionals who work with liquid mixing processes and equipment and wish to increase their knowledge and skills.

**Powder and Bulk Mixing: Processes, Applications and Equipment**

A course to explore technology and experience related to the processing of dry solids, with extensions to agglomeration, pastes, and doughs.

**Mixing in Glass-Lined Reactors**

A practical course on processing in glass- and polymer-lined reactors, emphasizing the unique features, advantages and limitations of such equipment.

Need to Know More?

Call toll free 800-462-0876 and ask for Program Director: Elaine M. Bower [bower@engr.wisc.edu](mailto:bower@engr.wisc.edu)

Program Associate: Theresa Jenneman [jenneman@epd.engr.wisc.edu](mailto:jenneman@epd.engr.wisc.edu)

Or e-mail [custserv@epd.engr.wisc.edu](mailto:custserv@epd.engr.wisc.edu)

General Information

Fee of $1795 Covers  Notebook, course materials, break refreshments, lunches, and certificate. We do not publish proceedings. Course materials are distributed only to participants.

Cancellation  If you cannot attend, please notify us by January 4, 2011, and we will refund your fee. Because this course has limited enrollment, cancellations received after this date and no-shows are subject to the full course fee of $1795. You may enroll a substitute at any time before the course starts.

Location and Accommodations This course will be held at the DoubleTree Guest Suites, in the Walt Disney World Resort, 2305 Hotel Plaza Boulevard, Lake Buena Vista, Florida 32830. We have reserved a block of sleeping rooms ($119/single or double) for course participants at the DoubleTree Guest Suites, in the Walt Disney World Resort. To reserve a room, call 407-842-1051 by December 11, 2010 and indicate that you will be attending this University of Wisconsin course. The group rate is also available three days prior to and three days following the main course dates.