

# Mixing XXI

Sponsored by the North American Mixing Forum

## Technical Program

Yarrow Resort & Conference Center

Park City, Utah

June 17 – 22, 2007

**SUNDAY**

8:00 am – noon Mountain View Room  Lunch for short course instructors & participants:  12:00–1:30 pm Corner Cafe.	<b>MIXING SHORT COURSE:</b> <b>Mixing in Pharmaceutical and Fine Chemical Manufacturing</b> <b>Co-Chairs: Art Etchells and Suzanne Kresta</b>  A group of experts will discuss and review the role of mixing in the batch manufacture of pharmaceuticals and other fine chemicals. The special problems associated with these type of operations will be reviewed including the role of regulation, peculiar equipment configurations, special effects of non-optimum equipment on process results and scale up and some special case studies. There will be four presenters from academia, consulting and industry.
2:00 – 4:00 pm Alpine Conference Room	<b>NAMF Council Meeting</b>
1:00 – 4:00 pm Kearns Room	<b>Exhibit Set-up</b>
2:00 – 6:00 pm Lobby	<b>REGISTRATION</b>
4:30 – 7:30 pm Kearns Room for Exhibit	<b>WELCOME RECEPTION, EXHIBIT, AND WESTERN BBQ</b>

7:30 – 10:00 pm Summit AB	<b>SESSION 1: FUNDAMENTALS OF MIXING TECHNOLOGY &amp; MIXING EDUCATION</b> <b>Co-Chairs: Chad Bennington and Midey Chang-Mateu</b>
7:30 pm	<b>Opening Comments From Conference Chairs</b> Hanh Vo, Dow Corning Corporation; and Kathy Barton, Lake Forest Academy
7:35 pm	<b>Process Design Elements of Agitated Columns</b> Julian Fasano, Mixer Engineering Company.
8 :00 pm	<b>Diffusion Confusion</b> E. B. Nauman, Rensselaer Polytechnic Institute
8:25 pm	<b>Simulation of Free Surface Flow in the Mixing Zone of an Annular Centrifugal Contactor</b> Kent E. Wardle, Todd R. Allen, Mark H. Anderson, and Ross Swaney, University of Wisconsin--Madison
8:50 pm	<b>Break</b>
9:05 pm	<b>Panel Discussion on Mixing and Education – Current State and NAMF’s Role</b> Led by Art Etchells with Bruce Nauman, Dave Dickey, Tom Simpson and Suzanne Kresta as panelists
10:00 – 11:30 pm Mountain View and Kearns Rooms	<b>SOCIAL HOUR AND EXHIBIT</b>

MONDAY			
7:00 – 8:00 am Summit C	<b>Breakfast</b>	5:40 – 7:00 pm	<b>DINNER</b> , Summit C
8:00 am – noon Summit AB	<b>SESSION 2: NOVEL EXPERIMENTAL METHODS</b> Co-Chairs: Dave Dickey and Suzanne Kresta	7:00 – 10:00 pm Summit AB	<b>SESSION 3: STATIC MIXERS AND OTHER IN-LINE MIXERS</b> Co-Chairs: Julian Fasano and John Middleton
8:00 am	<b>INVITED PLENARY</b> <b>Oscillations of Primary Circulation Loop of Agitated Liquid in a System with Pitched Blade Impeller</b>  Ivan Fort, Tomas Bruha, Oldrich Bruha, Milan Jahoda, and Pavel Hasal, <i>Czech Technical University in Prague</i>	7:00 pm	<b>CFD Modelling of Nano-Particle Clusters Break-Up In High-Shear Devices</b> Jerzy Baldyga, Wojciech Orciuch, Lukasz Makowski, Marek Henczka, Maciej Malski-Brodzicki and Katarzyna Malik, <i>Warsaw University of Technology, Poland</i>
9:00 am	<b>Use Of A High Speed Video System For The Characterization Of Multiphase Dispersions</b>  Eliane Guevara, María Soledad Córdova, Gabriel Corkidi and Enrique Galindo, <i>Universidad Nacional Autónoma de Mexico</i> .	7:25 pm	<b>Re-Dispersion Microreactor for The Formation of Liquid-Liquid Dispersions for Use In Polycondensation</b> Sonja Rothstock, Prasad Jadhavrao, Patrick Löb, Karl-Peter Schelhaas, Bernd Werner, <i>Inst. für Mikrotechnik Mainz GmbH, Chem.Prozess Technik, Univ. of Technology, Dept. of Chem. Eng. &amp; Chemistry</i> ; and David Agar, <i>University of Dortmund, Bio- u. Chemieingenieurwesen, Germany</i>
9:25 am	<b>On-Line Monitoring Of Crystallisation By Electrical Tomography As An Aid To Process Understanding, Scale-Up And Control</b>  Ken Primrose, <i>Industrial Tomography Systems Ltd, UK</i>	7:50 pm	<b>FMPSG/ICHEM Student Competition Winner</b> <b>Stereoscopic PIV study of the flow field generated by a sawtooth impeller</b> Heema Unadkat, <i>Loughborough University, UK</i>
9:50 am	<b>Break</b>	8:15 pm	<b>Break</b>
10:20 am	<b>Mixing Time for Liquid-Supercritical Phase Transition of n-Hexadecane-CO<sub>2</sub> Mixtures</b> G. Animescu, R. Lin and L.L. Tavlarides, <i>Syracuse University</i>	8:45 pm	<b>Mixing in a Multi-Inlet Vortex Mixer (MIVM) for Flash NanoPrecipitation</b> Ying Liu, Robert K. Prud'homme, <i>Princeton University</i> ; and Chungyin Cheng, Ying Liu, and Rodney O. Fox, <i>Iowa State University</i>
10:45 am	<b>CFD Modeling of Mixing In 5-Liter Laboratory Flask</b>  Arthur Kravchenko, I-Hwa Midey Chang-Mateu, <i>Rohm and Haas Company</i>	9:10 pm	<b>Flow And Mixing Characterization Of A Static Mixer Using Laser-Doppler Anemometry And Simultaneous Particle-Image - Velocimetry/Planar Laser-Induced Fluorescence</b> Stefan Leschka, Dominique Thévenin, Katharina Zähringer, <i>Lehrstuhl Strömungsmechanik &amp; Strömungstechnik, Inst. für Strömungstechnik &amp; Thermodynamik, Otto-von-Guericke, Universität Magdeburg, Germany</i>
11:10 am	<b>Designing of Impeller Properties</b>  Chris Hibshman, Wojciech Wyczalkowski, <i>Philadelphia Mixing Solutions, LTD</i>	9:35 pm	<b>Development of Plate Static Micromixer to Generate Multilamination of Fluid Layers by Splitting, 180-degree rotation and Recombination</b> Yushi Hirata, Yoshiro Inoue, <i>Division of Chem. Engineering, Grad.School of Eng. Science, Osaka University, Japan</i> ; and Kazuo Ohkawa, <i>Process Chemistry Laboratories, Astellas Pharma Co., Ltd, Japan</i>
11:35 am	<b>An In-Depth Assessment of the Measurement of Turbulent Mixing in a Vessel Stirred by a Rushton Turbine using Positron Emission Particle Tracking (PEPT) and its Comparison with PIV and Particle Tracking using CFD</b>  Fabio Chiti, Serafim Bakalis, Waldemar Bujalski, Alvin W. Nienow, Mostafa Barigou, <i>University of Birmingham, UK</i> ; and Archie Eaglesham, <i>Huntsman Polyurethanes, Belgium</i>	10:00 – 11:30 pm	<b>SOCIAL HOUR AND EXHIBIT</b> Mountain View and Kearns
noon – 1:00 pm Summit C	<b>Lunch</b>		
5:00 – 5:40 pm	<b>SOCIAL HOUR AND EXHIBIT</b> Mountain View and Kearns		

**TUESDAY**

7:00 – 8:00 am Summit C	<b>Breakfast</b>
8:00 am – noon Summit AB	<b>SESSION 4: MIXING AND REACTION</b> <b>Co-Chairs: Otute Akiti and Victor Atiemo-Obeng</b>
8:00 am	<b>INVITED PLENARY</b> <b>Mixing &amp; Reaction - What Happened Next?</b> <i>John Bourne, Retired Professor, Chemistry Department, ETH, Zurich</i>
9:00 am	<b>Effects Of Feed Pipe Backmixing on Micromixing: An Experimental Study</b> <i>Suat Peng Lee, Melissa Assirelli (speaker), Institute of Chemical and Engineering Sciences, Singapore; and Alvin W. Nienow, University of Birmingham, UK</i>
9:25 am	<b>NAMF Student Finalist</b> <b>Modeling a pilot-scale pulp mixing chest using CFD</b> <i>Clara Ford, Chad P.J. Bennington and Fariborz Taghipour, University of British Columbia, Vancouver, Canada</i>
9:50 am	<b>Break</b>
10:20 am	<b>Bubble Sizes in Agitated Water-Hydrophilic Organic Solvents for Heterogeneous Catalytic Hydrogenation Reactions: Simultaneous Bubble Size and Reaction Rate Measurement</b> <i>Alvin W. Nienow (speaker), Binjie Hu, Andrzej W. Pacek, J. Michael Winterbottom, Robert P. Fishwick, University of Birmingham, UK; and Hugh Stitt, Johnson Matthey Catalysts, UK</i>
10:45 am	<b>Realities of Process Intensification for Reactors</b> <i>John Middleton, BHR Group, UK</i>
11:10 am	<b>NAMF Student Finalist:</b> <b>Controlling Nanoparticle Agglomeration in a Confined Impinging Jet Reactor</b> <i>Shad W. Siddiqui, Peter Unwin, and Suzanne Kresta, University of Alberta, Canada</i>
11:35 am	<b>Review of Shortcut Closure Methods for Estimating Conversion and Yield in Mixed Reactors</b> <i>Gary K. Patterson, University of Missouri-Rolla, Rolla</i>
Noon – 1:00 pm Summit C	<b>Lunch</b>

4:30 – 5:40 pm Mountain View, Kearns and Ivans/Hearst	<b>SOCIAL HOUR AND EXHIBIT</b>
5:40 – 7:00 pm Summit C	<b>DINNER</b>
7:00-10:00 pm	<b>SESSION 5: VISCOUS AND NON-NEWTONIAN MIXING</b> <b>Co-Chairs: Piero Armenante and Dave Brown</b>
7:00 pm	<b>Spacial Statistics, Segregation and Definitions of Well Mixed</b> <i>Alena Kukukova, Joelle Aubin and Suzanne M Kresta, University of Alberta; Canada</i>
7:25 pm	<b>Laminar Mixing In Baffled And Unbaffled Tanks Using Central And Off-Centre Impeller Geometries</b> <i>J F Hall , M J H Simmons, E H Stitt, and M Barigou, Johnson Matthey Technology Centre UK, Dept. Formulation Engineering, University of Birmingham, Edgbaston, UK</i>
7:50 pm	<b>Engineering Fundamentals of Reactive Extrusion</b> <i>David Todd, Polymer Processing Institute, New Jersey Institute of Technology</i>
8:15 pm	<b>Break</b>
8:45 pm	<b>Dynamics of Pulp Stock Mixing Chests</b> <i>Chad P.J. Bennington, University of British Columbia, Canada</i>
9:10 pm	<b>Automation Of Non-Newtonian Blending Simulations - Building A Bridge From The Virtual World To The Process Engineer</b> <i>William Hartt, Krista Comstock, Hua Hu, Tim Laska, Mark Whaley, Samantha Bibart; David Peterson &amp; Eric Jones, The Procter and Gamble Company &amp; Enthought, Inc.</i>
9:35 pm	<b>Comparison of The mixing Performance of SHI's MAXBLEND*with Ekato's PARAVISC*, Co-axial Impellers and Standard Dual Open Impellers.</b> <i>Philippe Tanguy, URPEI-TOTAL Chair, École Polytechnique, Montréal, Canada Luciana Rudolph, Dow Olefinverbund GmbH, Merseburg, Germany, and Victor Atiemo-Obeng, The Dow Chemical Company, Midland Michigan</i>
10:00 – 11:30 pm Mountain View and Kearns	<b>SOCIAL HOUR AND EXHIBIT</b>

**WEDNESDAY**

7:00 – 8:00 am	<b>Breakfast / Summit C</b>
8:00 am – noon	<b>SESSION 6: INDUSTRIAL MIXING</b> <b>Session Chairs: Richard Cope and Roy Penney</b>
8:00 am	<b>Opening Comments to Dedicate This Session to Jim Oldshue</b> Tom Post, <i>Post Mixing, NY</i>
8:10 am	<b>The Effect of Reactor Mixing Equipment on Shear-Induced Agglomeration</b> Paul Gillis, John Blythe and Cesar Gonzalez, <i>Dow Chemical - Midland</i>
8:35 am	<b>Uniform Suspensions of Slow Settling Solids – Scale Up of Dispensing Tanks Equipped with Bottom-Mounted, Magnetic-Coupled Mixers</b> Eric Ricci and Billy R. Allen, Eli Lilly and Company
9:00 am	<b>Why Mixers Fail?</b> Todd Hutchinson, Wojciech Wyczalkowski, <i>Philadelphia Mixing Solutions LTD</i>
9:25 am	<b>Mixing in Sanitary Systems by Rotary Jet Heads: Fundamentals and Applications</b> Mikkel Nordkvist and John Åge Lazar, <i>ISO-MIX A/S, Denmark</i> ; Alvin Nienow, <i>University of Birmingham, UK</i> ; and John Villadsen, <i>Technical University of Denmark, Denmark</i>
9:50 am	<b>Break</b>
10:20 am	<b>Liquid-Liquid Suspension in Agitated Vessels: An Experimental and Correlational Study</b> W. Roy Penney, Timothy B. Jones, Melissa A. Myrick, Pamela I. Popejoy, Ricky W. Goff, <i>University of Arkansas.</i>
10:45 am	<b>New Advances in Mixing Technology for World Scale Reactors</b> Werner Himmelsbach and David Houlton, <i>EKATO RMT, Germany</i> ; and Mark Lovallo, <i>EKATO Corporation, USA</i>
11:10 am	<b>Solid Suspension and Distribution Studies with Single and Twin Impellers</b> David Brown and Chris Hampson, <i>BHR Group Limited, UK</i> ; and Kishore K. Kar, Richard F. Cope, Susan M. Kling and Kim A. James, <i>The Dow Chemical Company, USA</i>
11:35 am	<b>Introduction of posters (2 minutes for each poster)</b> <b>Chair: Shaffiq Jaffer</b>

Noon	<b>Call for nominations for NAMF Council</b>
12:10 – 1:10 pm	<b>Lunch / Summit C</b>
4:30 – 5:40 pm	<b>POSTER SESSION, SOCIAL HOUR AND EX HIBIT</b> Poster Room: Mountain View, Kearns and Ivans/Hearst
<b>P1</b>	<b>Emulsification Characterization Of A Dual-Shaft Mixer</b> Avinash R. Khopkar, Louis Fradette and Philippe A. Tanguy, <i>Ecole Polytechnique, Canada</i>
<b>P2</b>	<b>Mixing Software Development: The FMP Excel Design Guide</b> David Brown, Sat Panesar, BHR Group, UK
<b>P3</b>	<b>Experimental Study of Macro-scale Mixing in a Scale-Model Agitated Pulp Stock Chest using PIV</b> Clara Ford, Chad P.J. Bennington and Fariborz Taghipour, <i>The University of British Columbia Vancouver, Canada</i>
<b>P4</b>	<b>Mixing in Large Petroleum Storage Vessels</b> Chris Hastings and Wojciech Wyczalkowski, <i>Philadelphia mixing Solutions, LTD</i>
<b>P5</b>	<b>Predicting <math>k_{La}</math> From Correlations</b> John Middleton, <i>BHR Group, UK</i>
<b>P6</b>	<b>Novel Propeller Design Optimized For Mixing Employing Circular Rake, Helical, Parabolic Camber, and Skewed Blade Design Concepts</b> Robert W. Higbee, Wojciech Wyczalkowski; <i>Philadelphia Mixing Solutions Ltd.</i>
<b>P7</b>	<b>Simulation of Micromixing in Turbulent Tubular Reactors with Unmixed Feed</b> Pradyumna Kumar Parida and D. Phaneswara Rao, <i>Indian Institute of Technology, India</i>
<b>P8</b>	<b>Oil And Air Dispersion By Rushton And Smith Impellers Measured With High Speed Digital Video</b> Eliane Guevara, María Soledad Córdova and Enrique Galindo, <i>Universidad Nacional Autónoma de Mexico, MEXICO</i>
<b>P9</b>	<b>Mass Transfer Characteristics by Surface Aeration of Large Paddle Impeller: Application to Polymerization Reactor with Liquid Level Change</b> Ryuichi YATOMI, Katsuhide TAKENAKA, <i>SHI Mechanical &amp; Equipment INC. (Sumitomo Heavy Industries Group), Japan</i> ; Koji TAKAHASHI, <i>Yamagata University, Japan</i> ; and Philippe A. TANGUY, <i>Ecole Polytechnique, Canada</i>
<b>P10</b>	<b>Cavern Formation in Agitated Pulp Suspensions</b> Leo Hui, Chad P.J. Bennington and Guy A. Dumont, <i>University of British Columbia Vancouver, Canada</i>

<p><b>P11</b></p> <p><b>An Optimum Design for a Low Shear Hydrofoil Impeller through The Use of an Optimization Model Coupled With Computational Fluid Dynamics (CFD)</b></p> <p>N. Spogis, INTERNATIONAL TRADE CENTER , Brazil; and J. R. Nunhez; <i>Universidade Estadual de Campinas, Brazil</i></p> <p><b>P12</b></p> <p><b>Novel High Purity Oxygen Delivery System for Waste Water Applications</b></p> <p>Larry Coleman, <i>Praxair</i>, and Wojciech Wyczalkowski, <i>Philadelphia mixing Solutions, LTD</i></p> <p><b>P13</b></p> <p><b>Evaluation of Pulp Stock Chest Mixing Performance</b></p> <p>Ali Soltanzadeh, Guy A. Dumont, and Chad P.J. Bennington, <i>University of British Columbia Vancouver, Canada</i></p>	<p><b>DINNER</b> / Summit C</p>
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**WEDNESDAY (EVENING)**

7:00 – 10:00 pm Summit AB	<b>SESSION 7: CFD VERIFICATION AND VALIDATION</b> Co-Chairs: Phil Smith and Jennifer Spinti
7:00 pm	<b>The Pedagogy of Verification and Validation for Simulation Science of Mixing Processes</b> Philip J. Smith, <i>University of Utah</i>
7:25 pm	<b>Validation of Mixing and Reaction Models For Sooting Nonpremixed Turbulent Flames Using Direct Numerical Simulation</b> David Lignell, <i>Sandia National Laboratories (California)</i>
7:50 pm	<b>Experimental and Computational Comparisons of the Hydrodynamics in Two Differently Bottomed Partially Baffled Stirred Tank Reactor Systems Equipped with a Retreat Blade Impeller</b> Giuseppe Di Benedetto and Piero M. Armenante, <i>New Jersey Institute of Technology</i>
8:15 pm	<b>Break</b>
8:45 pm	<b>Validation of Turbulent Mixing in a Large Eddy Simulation of a Buoyant Helium Plume</b> J. Thornock, Z. Gao, S. Borodai, J. P. Spinti, and P. J. Smith, <i>University of Utah</i>
9:10 pm	<b>Validating CFD Models for Slurry Mixing Using Pulse-Jet Mixers</b> Brigitte Rosendall, Chris Barringer, Feng Wen, <i>Bechtel National, Inc. San Francisco, CA</i>
9:35 pm	<b>Influence of Merging, Parallel and Diverging Flow Patterns on Gas-Liquid Flows in a Tall Stirred Vessel: Some numerical experiments</b> Avinash R. Khopkar and Philippe A. Tanguy, <i>Ecole Polytechnique, Canada</i>
10:00 – 11:30 pm Mountain View and Kearns	<b>SOCIAL HOUR AND EXHIBIT</b>

**THURSDAY**

7:00 – 8:30 am	<b>Breakfast / Summit C</b>
8:00 am – 12:10 pm Summit AB	<b>SESSION 8: MULTIPHASE MIXING</b> <b>Co-Chairs: Richard Calabrese and Enrique Galindo</b>
8:00 am	<b>Emulsions and Emulsification: Status and Future Challenges</b> Shaffiq Jaffer, <i>The Procter and Gamble Company</i> ; and Alvin Nienow, <i>University of Birmingham, UK</i>
8:40 am	<b>Turbulent Liquid-Liquid Dispersions</b> Jos Derksen and Harry van den Akker, <i>Delft University of Technology, Netherlands</i>
9:05 am	<b>NAMF Student Finalist: Gas-Liquid Mass Transfer In Unbaffled Dual-Impeller Mixers</b> Francois Cabaret, Louis Fradette and Philippe A. Tanguy, <i>URPEI, Department of Chemical Engineering, Ecole Polytechnique, Montreal, Canada</i>
9:30 am	<b>A Comparison of Traditional Rushton Disc Turbines with High Solidity Ratio, Up-pumping, Axial Hydrofoil Impellers in 550 L Pilot Scale Aerobic Submerged Fermentations</b> Stuart M Stocks, <i>Novozymes A/S, Denmark</i> ; and Alvin W. Nienow, <i>University of Birmingham, UK</i>
9:55 am	<b>Break</b>
10:20 am	<b>Energy And Mass Transfer In Dispersed Gas-Liquid Reactors</b> John M Smith, <i>University of Surrey, UK</i>
10:45 am	<b>Particle Tracking Simulations in an Inline Rotor-Stator Mixer to Aid in the Prediction of Drop Size Distribution</b> Karl R. Kevala, Kenneth T. Kiger and Richard V. Calabrese, <i>University of Maryland</i>
11:10 am	<b>Solids Suspension Using Unbaffled Angled Agitation</b> Jonathan P. Herr and Kevin J. Myers & Eric E. Janz and Joel D. Duvall and Julian B. Fasano, <i>University of Dayton, Chemineer, Inc and Mixer Engineering Co</i>
11:35 am	<b>Intensifying Inter-phase Mass Transfer in Air Lift Reactors Handling Industrial Streams</b> A.M. Al Taweel, S. K. Pallapothu, H.G. Gomaa and A. Ghanem, <i>Dalhousie University, Halifax NS, Canada</i>
12:00	<b>NAMF Council Election Ballot</b>

12:10 – 1:10 pm	<b>Lunch / Summit C</b>
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4:30 – 5:30 pm Summit AB	<b>NAMF GENERAL MEETING</b>
5:30 – 6:00 pm Mountain View and Kearns	<b>SOCIAL HOUR AND EXHIBIT</b>
6:00-7:30 pm Summit AB	<b>AWARDS DINNER</b>
7:45 – 10:00 pm Summit AB	<b>SESSION 9: TO HONOR/ COMMEMORATE JIM OLDSHUE</b> <b>Session Chairs: Larry Tavlarides and Ron Weetman</b>
7:45 pm	<b>Opening Remark</b> Ron Weetman, <i>RJWeetman.com</i>
7:50 pm	<b>Mixer Design and Operating Issues in Sufuric Acid Catalyzed Alkylolation Reactors</b> Ramesh Hemrajani, <i>Mixing &amp; Reactor Solutions</i>
8:15 pm	<b>Optimization Of Mixing In Agitated Horizontal Tank Reactors</b> Tom Post, Darryn McClelland, Keith Johnson, and Herman Pieterse, <i>Post Mixing, NY</i>
8:40 pm	<b>Mechanical Scale-up and Problems of Mixing Systems</b> Ronald J. Weetman, <i>RJWeetman.com</i> , Paul Kubera, <i>ABEC, Inc.</i> ; Gerry Dubois, <i>STI Technologies, Inc.</i> ; and Mac Kendall, <i>Biogen Idec</i>
9:05 pm	<b>Break</b>
9:20 pm	<b>Slide Show And Presentations To Celebrate Jim Oldshue's Life And His Many Contributions To Mixing And Other Areas</b> Ron Weetman, <i>RJWeetman.com</i> ; Bernie Gigas, <i>Lightnin</i> , and other individuals
10:00 – 11:30 pm Mountain View and Kearns	<b>SOCIAL HOUR AND EXHIBIT</b>

**FRIDAY, 8:30 – 10:30 am**

**FAREWELL BRUNCH: 8:30 – 10:00 am, Summit C**  
**PLEASE SIGN UP BY MONDAY NOON**