

# North American Mixing Forum

## Mixing XXVI



**June 24-29, 2018**

**The Vanderbilt Hotel, San Juan, Puerto Rico**

### **Conference Organizers:**

Luis Sierra, MSD (also known as *Merck in USA*), *Singapore*  
Piero Armenante, *New Jersey Institute of Technology, Newark, NJ, USA*  
Clara Gomez, *Coanda, Canada*

### **Conference Program**

(Updated on June 25, 2018)

Sponsored by:



## Sunday Morning, June 24, 2018

9:00 am-2:45 pm – Tutorials at Salon Luchetti

<b>Short Courses</b>	
9:00 am	<b>Course Introduction</b>
9:00 am	<b>Introduction to Mixing</b> <i>Suzanne Kresta - University of Saskatchewan, Canada</i>
9:45 am	<b>Computational Fluid Dynamics &amp; Mixing</b> <i>Minye Liu -Chemours, USA</i>
10:25 am	<i>Coffee Break &amp; Discussions</i>
10:40 am	<b>Experimental Methods &amp; Mixing</b> <i>David Brown – BHR Group, UK</i>
11:20 am	<b>Liquid-Liquid Dispersions</b> <i>Richard Calabrese - University of Maryland, USA</i>
12:00 pm	<b>Gas-Liquid Mixing</b> <i>Justin Walker – The Dow Chemical Company, USA</i>
12:35 pm	<i>Lunch</i>
1:25 pm	<b>Solid-Liquid Mixing</b> <i>Richard Grenville – Philadelphia Mixing Solutions, USA</i>
2:00 pm	<b>Special Topic - Mixing in the Pharmaceutical Industry</b> <i>Piero Armenante - New Jersey Institute of Technology, USA</i>

## Sunday Afternoon, June 24, 2018

1:00 pm- 4:30 pm – Registration at Pre-Function Patio del Fauno

<b>Registration</b>	
1:00 pm	<b>Registration</b>

1:00 pm- 4:00 pm – Exhibit Set-Up Patio del Fauno West

<b>Exhibits</b>	
1:00 pm	<b>Exhibit Set - up</b>

4:30 pm- 7:00 pm – Welcome Reception at East Veranda

<b>Welcome Reception</b>	
4:30 pm	<b>Cocktail Reception</b>
5:00 pm	<b>Noche de San Juan Dinner Buffet</b>

## Sunday Evening, June 24, 2018

7:00 pm-7:15 pm – Welcoming Remarks at Patio del Fauno Ballroom

Luis Sierra  
Piero Armenante  
Clara Gomez

7:10 pm-10:00 pm – Presentations at Patio del Fauno Ballroom

<b>Mixing in Biological and Aerated Systems</b>	
<i>Chair: Suzanne Kresta - University of Saskatchewan, Canada</i> <i>Co-Chair: Richard Cope – Alkermes, USA</i>	
7:15 pm	<b><i>Scale-Down Studies Related to Agitation Intensity For The Scale-Up Of Trichoderma Reesei Fermentations Producing Cellulases In Stirred Bioreactors (Plenary Session)</i></b> Alvin Nienow (presenter) - University of Birmingham, United Kingdom
8:00 pm	<b><i>Estimating oxygen transfer rates and gas hold-up for pilot-scale fermentation processes from engineering correlations accuracy and limitations</i></b> Billy Allen (presenter) - BioProcessMixing, USA
8:25 pm	<b><i>Lights, camera, action!... Inside a bioreactor: the behavior of air bubbles and oil drops as it really happens in 3D and high speed</i></b> Enrique Galindo (presenter) - Institute of Biotechnology, UNAM, Mexico
8:50 pm	<i>Break</i>
9:10 pm	<b><i>Measuring Gas Hold-up Profiles in G/L Stirred Tanks using an Electrical Resistance Tomography Linear Probe</i></b> Giuseppe Forte (presenter) - University of Birmingham, Johnson Matthey, United Kingdom
9:35 pm	<b><i>Improved Mixing in a Multiphase Rotating Bioreactor with Internal Spiroid</i></b> Thomas Hanley, Shu Fang (presenter), Paul Todd - Auburn University, Techshot, Inc., USA

10:00 pm-11:00 pm – Happy Hour at East Veranda

## Monday Morning, June 25, 2018

7:00 am-8:00 am – Breakfast at Salon Dorado

8:00 am-12:00 noon – Presentations at Patio del Fauno Ballroom

<b>Mixing in Pharmaceutical Systems</b>	
<i>Chair: Luis Sierra – MSD (also Known as Merck in the USA), Singapore</i>	
<i>Co-Chair: Otuti Akiti – BlackThorn, USA</i>	
8:00 am	<b><i>Old Problems and Emerging Opportunities...Why Mixing in Pharma Continues to Challenge</i></b> <b><i>(Plenary Presentation)</i></b> <i>Aaron Cote, Merck</i>
8:45 am	<b><i>Using a practical DOE with mixer design / operation parameters, to scale up a pharmaceutical crystallizer while controlling particle size</i></b> <i>Hector Guzman (presenter) - Alkermes, USA</i>
9:10 am	<b><i>Computational Prediction and Experimental Determination of Power Numbers for a Retreat-Blade Impeller in Fully and Partially Baffled Tanks</i></b> <i>Adam Bindas (presenter and student competition finalist), Chadakarn Sirasitthichoke, Piero Armenante - New Jersey Institute of Technology, USA</i>
9:35 am	<b><i>The Fourth Bourne Reaction Reveals Flow Reactor Design Features Important for Fast Reaction Performance at Production Scale</i></b> <i>Nicholas Rogus, Glenn Spencer (presenter) - Merck, USA</i>
10:00 am	<i>Coffee Break at West Veranda</i>
10:20 am	<b><i>Scale-up of anti-solvent crystallization using single phase CFD analysis</i></b> <i>Mothivel Mummudi (presenter), Ameya Durve, Tarang Bulchandani, Gopal Kasat - Tridiagonal Solutions Inc., USA</i>
10:45 am	<b><i>Experimental Determination and Computation Validation of Mixing Efficiency in a Simple, Continuous, Laminar-Flow Microdevice</i></b> <i>Siril Arockiam, Sagnik Basuray (presenter), Piero Armenante – New Jersey Institute of Technology, USA</i>
11:10 am	<b><i>Panel Discussion: Mixing Issues and Challenges in the Pharmaceutical Industry</i></b> <i>Moderators: Aaron Cote, Merck; Piero Armenante, New Jersey Institute of Technology; Hector Guzman</i>

12:00 noon-1:00 pm – Lunch at Salon Dorado

## Monday Afternoon, June 25, 2018

2:00 pm-4:00 pm – NAMF Council meeting at Salon Luchetti

4:00 pm-5:00 pm – Poster Session and Exhibit at Patio del Fauno West

5:00 pm-6:00 pm – Happy Hour at West Veranda

6:00 pm-7:00 pm – Dinner at Salon Dorado

## Monday Evening, June 25, 2018

7:10 pm-10:00 pm - Presentations at Patio del Fauno Ballroom

<b>Novel Mixing Systems and Experimental Methods</b>	
<p><i>Chair: Richard Calabrese - University of Maryland, USA</i>  <i>Co-Chair: David Brown – BHR Group, UK</i></p>	
7:10 pm	<p><b><i>Liquid Mixing in a Rotating Packed Bed Pilot Plant</i></b>  <i>Dennis Wenzel, Melissa Assirelli, Andrzej Górak - TU Dortmund University, Huntsman Polyurethanes, Lodz University of Technology, Germany, Poland</i></p>
7:35 pm	<p><b><i>Experimental Techniques for Contacting of Solids with Heavy Hydrocarbon Liquids in Co-Rotating Twin Screw Mixers</i></b>  <i>Ramesh Hemrajani (presenter) - Mixing and Reactor Solutions, USA</i></p>
8:00 pm	<p><b><i>Interrogation of Mixing in Custom High-Speed Rotor/Stator Wetmill</i></b>  <i>Aaron Cote, Athanas Koynov, Robert O'Connor, Luke Schenck - Merck, USA</i></p>
8:25 pm	<p><i>Coffee Break at West Veranda</i></p>
8:45 pm	<p><b><i>The measurement of the mass transfer dynamics in the segmented flow of a dissolving gas and a liquid: Theory and experiments</i></b>  <i>Ghata Nirmal (presenter and student competition finalist) - University of Toronto, Canada</i></p>
9:10 pm	<p><b><i>The Power Number of a Magnetic Stir Bar</i></b>  <i>David Adrian, Sarat Kuchibhatla, Suraj Deshpande, Jim Pressler - The Dow Chemical Company, USA</i></p>
9:35 pm	<p><b><i>The revelation of key parameters controlling hydrodynamic of planetary mixers through dimensional analysis</i></b>  <i>Guillaume Delaplace - INRA , France</i></p>

10:00 pm-11:00 pm – Happy Hour at West Veranda

## Tuesday Morning, June 26, 2018

7:00 am-8:00 am – Breakfast at Salon Dorado

8:00 am-12:00 noon – Presentations at Patio del Fauno Ballroom

<b>CFD Simulation of Mixing Processes</b>	
<i>Chair: François Bertrand – Ecole Polytechnique de Montréal, Canada Co-Chair: John Thomas - M-Star CFD, USA</i>	
8:00 am	<b><i>Simulating Emulsions and Emulsification by Means of a Pseudo-Potential Lattice Boltzmann Model (Plenary Session)</i></b> Harry Van den Akker, Robert Kedzierski - University of Limerick, Ireland
8:45 am	<b><i>CFD Simulation of a Pulse Jet Mixed Vessel</i></b> Jung Kim, Richard Calabrese (presenter), Christopher P. Guenther, Yong Liu - University of Maryland; National Energy Technology Laboratory; AECOM, USA
9:10 am	<b><i>Large Eddy Simulation of Blending in Large Storage Tanks</i></b> Brian DeVincentis, Kevin Smith, John Thomas - M-Star CFD, USA
9:35 am	<b><i>Revised algorithm for creating mixing impeller hydraulic force angle versus time plots using both Lattice-Boltzmann CFD and lab data including the implications for agitator shaft fatigue design.</i></b> Robert Higbee - Philadelphia Mixing Solutions Ltd., USA
10:00 am	<i>Coffee Break at West Veranda</i>
10:20 am	<b><i>Chaotic mixing in a barrier-embedded partitioned pipe mixer and its application to a crossflow filtration</i></b> Tae Gon Kang, Haein Jung, Seon Yeop Jung, Kyung Hyun Ahn - Korea Aerospace University, Seoul National University, South Korea
10:45 am	<b><i>Lattice Boltzmann modeling of immiscible liquid-liquid flows in static mixers</i></b> Sébastien Leclaire, David Vidal, Louis Fradette, François Bertrand - Polytechnique Montréal, Canada
11:10 am	<b><i>Optimal design of a novel static mixing device using Computational Fluid Dynamics</i></b> Krishnaswamy Nandakumar - Louisiana State University, USA
11:35 am	<b><i>Industrial Perspective on LES Simulations of Mixing Tanks</i></b> Roberto Irizarry (presenter), Matt Flamm, Zyne Kalal - Merck, USA

12:00 noon-1:00 pm – Lunch at Salon Dorado

## Tuesday Afternoon, June 26, 2018

5:00 pm-6:00 pm –Happy Hour at West Veranda and Posters Session at Patio del Fauno West

6:00 pm-7:00 pm – Dinner at Salon Dorado

## Tuesday Evening, June 26, 2018

7:10 pm-10:00 pm - Presentations at Patio del Fauno Ballroom

<b>Modeling and Simulation of Mixing Processes</b>	
<i>Chair: Minye Liu -Chemours, USA</i> <i>Co-Chair: Federico Alberini - University of Birmingham, United Kingdom</i>	
7:10 pm	<b><i>Mechanism and models of drop breakup and mass transfer in liquid-liquid systems (Plenary Session)</i></b> Jerzy Baldyga, Magdalena Jasinska - Warsaw University of Technology, Poland
7:55 pm	<b><i>CFD Multiphase Study on Drum Tumbler Cold Blending</i></b> Chang Kai Wu, Hongjun Ma - The Dow Chemical Company, USA
8:20 pm	<i>Coffee Break at West Veranda</i>
8:45 pm	<b><i>Big Tanks and Small Dip Tubes: Application of Variable Mesh Lattice-Boltzmann</i></b> Justin Walker, Sarat Kuchibhatla, John Thomas, Brian DeVincentis - The Dow Chemical Company, M-Star Simulations, USA
9:10 pm	<b><i>Mixing Times and Impeller Eccentricity in Non-Turbulent Stirred Vessels</i></b> Harry Van den Akker - University of Limerick, Ireland
9:35 pm	<b><i>Transient Mean Age Analysis in Large Eddy Simulation</i></b> John Thomas, Minye Liu - M-Star Simulations, Chemours, USA

10:00 pm-11:00 pm – Happy Hour at West Veranda

## Wednesday Morning, June 27, 2018

7:00 am-8:00 am – Breakfast at Salon Dorado

8:00 am-12:00 noon – Presentations at Patio del Fauno Ballroom

<b>Mixing in Single Phase Systems</b>	
<i>Chair: Arthur Etchells, Robert Hesketh - Rowan University, USA</i> <i>Co-Chair: Alexandra Komrakova - University of Alberta, Canada</i>	
8:00 am	<b><u>Vortexes in Unbaffled Tanks</u></b> Arthur Etchells, Robert Hesketh - Rowan University, USA
8.25 am	<b><u>Blending in Un-Baffled Stirred Tanks with Off-Centred Agitators</u></b> David Okonkwo, Gustavo Padron - BHR Group, United Kingdom
8:50 am	<b><u>Blend Time in the Confined Impeller Stirred Tank: Effect of Impeller Geometry and Reynolds Number on the Behavior of Compartmentalization</u></b> Marcio Machado, Khilesh Jairamdas, Nicol Pinto, Akshay Bhalerao, Suzanne Kresta (presenter)- University of Alberta, Canada
9:15 am	<b><u>Flow studies in an in-line Silverson 150/250 high shear mixer using PIV</u></b> Cyrus Espinoza, Mark Simmons, Federico Alberini, Adam Kowalski, Olga Mihailova - University of Birmingham, Unilever, United Kingdom
9:40 am	<b><u>Blending of Stratified Liquids with Side-Entering Agitators</u></b> Ben A. Boyer (Presenter), Jason J. Giacomelli, R. K. Grenville - Philadelphia Mixing Solutions Ltd., Greg O. VanOmmeren - Rowan University , USA
10:05 am	<i>Coffee Break at West Veranda</i>
10:20 am	<b><u>Investigation of Blend Time for Turbulent Newtonian Fluids in Stirred Tanks: A Second Analysis</u></b> Aaron Strand - SPX Flow Lightnin, USA
10:45 am	<b><u>Towards Rheological Measurements in Stirred Vessels</u></b> Federico Alberini - University of Birmingham, United Kingdom
11:10 am	<b><u>Complex Reactive Flows Including Mixing-Limited Reactions: Models and Experiments</u></b> Paul Gillis, Quan Yuan, Sarat Kuchibhatla - The Dow Chemical Company, USA
11:35 am	<b><u>Practical Methods for Process Scale-Up</u></b> Moshe Bentolila - VisiMix, Israel

12:00 pm-1:00 pm – Lunch at Salon Dorado

## Wednesday Afternoon, June 27, 2018

5:00 pm-6:00 pm –Happy Hour West Veranda and Posters Session and Exhibit at Patio del Fauno West

6:00 pm-7:00 pm – Dinner at Salon Dorado



## Wednesday Evening, June 27, 2018

7:10 pm-10:00 pm - Presentations at Patio del Fauno Ballroom

<b>Mixing in Multiphase Systems I</b>	
<p><i>Chair: Alvin Nienow - University of Birmingham, United Kingdom</i>  <i>Co-Chair: Richard Grenville – Philadelphia Mixing Solutions, USA</i></p>	
7:10 pm	<p><b><i>Liquid-Liquid Drawdown: Effect of Mixing Energy on the Transient Chord Length Distribution in Different Tank Geometries</i></b>                      Marcio Machado, Fatemeh Safari-Alamuti, Akshay Bhalerao, Alexandra Komrakova, Suzanne Kresta - University of Alberta, Canada</p>
7:35 pm	<p><b><i>Development of an Observer-Independent Experimental Method for the Determination of the Minimum Agitation Speed for Solids Suspension in Stirred Tank Reactors</i></b>                      Shriarjun Shastry, Piero Armenante (presenter) - New Jersey Institute of Technology, USA</p>
8:00 pm	<p><b><i>Wet milling of crystals in high shear mixers. Part II: mechanistic models to predict particle size reduction</i></b>                      Kanan Ghaderzadeh (presenter and student competition finalist), Richard Calabrese - University of Maryland, USA</p>
8:25 pm	<p><i>Coffee Break at West Veranda</i></p>
8:45 pm	<p><b><i>Development of Sub-Models for Multi-Scale Simulations of Turbulent Liquid-Liquid Dispersions</i></b>                      Alexandra Komrakova, Cheng Zhong - University of Alberta, Canada</p>
9:10 pm	<p><b><i>Selection of Impellers for Optimum Mixing Performance</i></b>                      Richard Grenville, Benjamin Boyer, Jason Giacomelli, Robert Dowd - Philadelphia Mixing Solutions Ltd., USA</p>
9:35 pm	<p><b><i>The application of mixing tanks in Canada’s oil sand mining industry</i></b>                      Sean Sanders, Reza Hashemi, Melissa McKibben, John-Paul Portelli, Jason Schaan - University of Alberta, Saskatchewan Research Council, Canadian Natural Resources Limited, Canada</p>

10:00 pm-11:00 pm – Happy Hour at West Veranda

## Thursday Morning, June 28, 2018

7:00 am-8:00 am – Breakfast at Salon Dorado

8:00 am-12:00 pm – Presentations at Patio del Fauno Ballroom

<b>Mixing in Multiphase Systems II</b>	
<i>Chair: Enrique Galindo - Institute of Biotechnology, UNAM, Mexico</i>	
<i>Co-Chair: Sagnik Basuray – NJIT, USA</i>	
8:00 am	<b><i>Effect of Impeller to Tank Diameter Ratio and Scale on the Solids Cloud Height in Stirred Vessels</i></b> David Brown - BHR Group, United Kingdom
8.25 am	<b><i>Solids suspension and power draw characteristics with impeller types common to glass-lined chemical reactors</i></b> Richard Shields - Eli Lilly and Company, USA
8:50 am	<b><i>Rheological analysis of municipal solid waste (MSW) pulp in enzymatic hydrolysis: from bench to pilot-scale</i></b> Fernando Climent Barba, Richard Bourne, Nikil Kapur, John Blacker - University of Leeds, United Kingdom
9:15 am	<b><i>Bubble-scale Modeling of Gasified Reactors</i></b> Christopher Tyler (presenter), John Thomas, Billy Allen - Cargill, M-Star Simulations, BioProcessMixing, USA
9:40 am	<b><i>Gas holdup and impacts on Njs in 3-phase (G/L/S) mixing tanks</i></b> Sean Sanders, Reza Hashemi, Melissa McKibben, John-Paul Portelli, Jason Schaan - University of Alberta, Saskatchewan Research Council, Canadian Natural Resources Limited, Canada
10:05 am	<i>Coffee Break at West Veranda</i>
10:20 am	<b><i>Heterogeneous catalysis with internal recirculation = Gasjet</i></b> Wolfgang Last - Ekato Rühr-und Mischtechnik GmbH, Germany
10:45 am	<b><i>Integrating Mixing into the Undergraduate Transport Phenomena Sequence</i></b> Richard Calabrese - University of Maryland, USA
11:10 am	<b><i>Panel Discussion: Mixing Issues and Challenges in the Pharmaceutical Industry</i></b> Moderators: Aaron Cote, Piero Armenante, Hector Guzman, Billy Allen
11:40 am	<b><i>Panel Discussion: Mixing Challenges and Future Directions</i></b> Moderators: Richard Grenville, Luis Sierra, Piero Armenante, Billy Allen

12:30 pm-1:30 pm – Lunch at Salon Dorado

## Thursday Afternoon, June 28, 2018

5:00 pm-6:00 pm –Happy Hour Pre Function Patio del Fauno

## **Thursday Evening, June 28, 2018**

7: 00 pm – Banquet at Patio del Fauno Ballroom

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## **Friday Morning, June 29, 2018**

Breakfast at Salon Dorado

## Posters

<p><b><i>Integrating Mixing into an Elective Course on Turbulence &amp; Multiphase Flow</i></b> Richard Calabrese - University of Maryland, USA</p>
<p><b><i>The Effect of Sparge Type on Oxygen Mass Transfer and Gas Dispersion for Minerals Processing Gassed Reactors</i></b> Richard Kehn - SPX FLOW (Lightnin Mixers), USA</p>
<p><b><i>Break-up of Single Droplets in a Laminar 2-D Orifice Flow</i></b> Derrick Ko (Student Poster Competition Finalist), Richard Calabrese - University of Maryland, USA</p>
<p><b><i>A Study on the Effective Design Methodology of the Mixer Draft Tube Assembly</i></b> Sang Jin Lee - Philadelphia Mixing Solutions, Ltd, USA</p>
<p><b><i>Large Eddy Simulations of an Axial Discharge Rotor-Stator Mixer</i></b> Benjamin Minnick, Richard Calabrese - University of Maryland, USA</p>
<p><b><i>Efficient Computational Strategies for Industrial Solids Mixing</i></b> Mothivel Mummudi, Aashish Goyal, Mitali Basargi, Aditya Joshi - Tridiagonal Solutions Inc., USA</p>
<p><b><i>Using tomography and computational fluid dynamics to assess the local solid concentrations in a slurry reactor equipped with a Maxblend impeller</i></b> Prakash Mishra (Student Poster Finalist), Farhad Ein Mozaffari – Ryerson University, Canada</p>