



June 22 – 27, 2014 | The Sagamore, Lake George, NY, USA

FINAL PROGRAMME

SUNDAY MORNING – SHORT COURSE

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| 8:30 am | <p>Characterizing impellers: flow versus shear
 R. K. Grenville, Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA</p> |
| 9:15 am | <p>Blending of miscible liquids
 D. A. R. Brown, The British Hydromechanics Research Group, Cranfield, UK</p> |
| 10:00 am | Break |
| 10:15 am | <p>Gas-liquid mixing
 T. Post, Post Mixing Optimization and Solutions LLC, Pittsford, NY, USA</p> |
| 11:00 am | <p>Solid-liquid mixing
 T. A. Simpson, DuPont Engineering, Wilmington, DE, USA</p> |
| 11:45 am | <p>Liquid-liquid mixing
 G. Padron, The British Hydromechanics Research Group, Cranfield, UK</p> |
| 12:30 pm | Lunch |
| 1:00 pm | <p>Mixing and chemical reactions
 R. K. Grenville, Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA</p> |
| 1:45 pm | <p>Mixing of complex fluids
 C. Gomez, Coanda Research and Development Corp., Burnaby, BC, Canada</p> |
| 2:30 pm | <p>Computational fluid dynamics
 M. Liu, DuPont Engineering, Wilmington, DE, USA</p> |

SUNDAY EVENING – MIXING IN MOTIONLESS DEVICES

Chairs: **A. W. Etchells III, Retired**
M. B. Machado, University of Alberta, Edmonton, AB, Canada

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| 7:00 pm | <p>Welcome
 T. Post¹ and R. K. Grenville²
 1. Post Mixing Optimization and Solutions LLC, Pittsford, NY, USA.
 2. Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.</p> |
| 7:10 pm | <p>Plenary: Future of energy: R&D challenges in process engineering
 S. Jaffer, Total SA, Boston, MA, USA.</p> |
| 7:50 pm | <p>A flexible and energy-efficient in-line multiphase static mixer
 F. Azizi¹ and A. M. Al Taweel²
 1. American University of Beirut, Beirut, Lebanon.
 2. Dalhousie University, Halifax, NS, Canada.</p> |
| 8:15 pm | <p>Laminar mixing in 3D and quasi-2D confined impinging jets
 C. P. Fonte, R. J. Santos, M. M. Dias and J. C. B. Lopes
 Laboratory of Separation and Reaction Engineering, Faculty of Engineering, University of Porto, Portugal.</p> |

8:40 pm	<p>An opposed jet, process flow geometry: three-dimensional experimental results and simulation for verification</p> <p>R. S. Brodkey¹, M. Nilsen², A. Yusuf², A. Brown², M. Garcia², A. Kiprovska², J. Knight², E. Lynch², T. Yang², Y. Zhao² and S. Nakamura³</p> <ol style="list-style-type: none"> 1. Retired. 2. Department of Chemical and Biomolecular Engineering, The Ohio State University, Columbus, OH, USA. 3. Department of Mechanical Engineering, The Ohio State University, Columbus, OH, USA.
9:05 pm	<p>Flow phenomena of wormlike micelle solutions in static mixers</p> <p>W. Hartt¹, L. Bacca¹ and E. Tozzi²</p> <ol style="list-style-type: none"> 1. The Procter & Gamble Company, West Chester, OH, USA. 2. Aspect Imaging, Shoham, Israel.
9:30 pm	<p>Numerical study on fluid mixing in droplet-based microfluidics with a serpentine micro-channel</p> <p>L. Feng and J. Wang</p> <p>Department of Chemical and Biological Engineering, Zhejiang University, Hangzhou, PR China.</p>
9:55 pm	Social hour

MONDAY MORNING – MIXING IN BIOREACTORS

Chairs: C. Gomez, Coanda Research and Development Corp., Burnaby, BC, Canada.
R. Hemrajani, Retired.

8:00 am	<p>Stirred, not shaken: mixing issues in stem cell culture</p> <p>A. W. Nienow¹, Q.A. Rafiq², K. Coopman², and C.J. Hewitt²</p> <ol style="list-style-type: none"> 1. Retired. 2. Center for Biological Engineering Loughborough University, Loughborough, UK.
8:25 am	<p>Oxygen transfer at high power and superficial gas velocities: limitations and accuracy of correlations to predict k_{La} and gas hold-up in commercial fermentation processes</p> <p>B. R. Allen</p> <p>Eli Lilly and Company, Indianapolis, IN, USA.</p>
8:50 am	<p>Mixing characteristics of a model anaerobic digester</p> <p>S. C. Low, R. Parthasarathy, N. Eshtiaghi and P. Slatter</p> <p>School of Civil, Environmental and Chemical Engineering, RMIT University, Melbourne, Australia.</p>
9:15 am	<p>Progressing towards a more complete understanding of modern industrial scale aerobic fermentation processes</p> <p>S.M. Stocks, A. Nørregård, K. Gernaey, Bryde-Jacobsen, L.R. Formenti, and B. Madsen</p> <p>Novozymes A/S, Bagsvaerd, Denmark.</p>
9:40 am	Break
10:10 am	<p>Plenary: EPIC – Enabling process innovation through computation</p> <p>K. Nandakumar</p> <p>Louisiana State University, Baton Rouge, LA, USA.</p>
10:50 am	<p>Multiphase flow in an orbitally shaken bioreactor</p> <p>I. Pieralisi¹, G. Rodriguez², M. Micheletti², A. Paglianti¹ and A. Ducci³</p> <ol style="list-style-type: none"> 1. Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Bologna, Italy. 2. Biochemical Engineering Department, University College London, London, UK. 3. Mechanical Engineering Department, University College London, London, UK.
11:15 am	<p>Energy efficient mixing and aeration in oxidation ditches</p> <p>E. Riess-Gonzalez, T. Frey and M. Höfken</p> <p>INVENT Environmental Technologies Inc., Cedar Grove, NJ, USA.</p>

11:40 am An energy-saving solution pays big dividends - Madison MSD Nine Springs WWTP: Activated sludge selector mixing system
J. F. Fischer, Xylem Water Solutions, Pewaukee, WI, USA.

12:05 pm Lunch

MONDAY AFTERNOON – INTRODUCTION OF POSTER PRESENTERS

Chairs: T. Post, Post Mixing Optimization and Solutions LLC, Pittsford, NY, USA.
R. K. Grenville, Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.

4:00 pm Poster presentations

5:00 pm Social hour and Poster session

MONDAY EVENING – APPLICATIONS OF CFD FOR MIXING PROCESSES

Chairs: O. Akiti, Relypsa Inc., Redwood City, CA, USA.
G. Padron, The British Hydromechanics Research Group, Cranfield, UK.

7:00 pm Predicting the turbulent mixing performance of augers using high-fidelity CFD
J. A. Thomas
M-Star Simulations LLC, Baltimore, MD, USA.

7:25 pm Some issues of characterizing impeller performance for turbulent blending
M. Liu
DuPont Engineering, Wilmington, DE, USA.

7:50 pm Progress on annular centrifugal contactor design: hybrid multiphase CFD and rapid prototyping
K. E. Wardle
Argonne National Laboratory, Argonne, IL, USA.

8:15 pm Break

8:40 pm Improving Euler-Granular models in multiphase mixing for poly-dispersed flows
B. Rosendall¹, M. Kinzel², J. L. Feng³, S. Lo³, L. J. Peltier¹, A. Rizhakov¹, and K. Knight¹
1. Bechtel National Inc., Reston VA, USA.
2. Pennsylvania State University, State College, PA, USA.
3. CD-adapco, Melville, NY, USA.

9:05 pm Bubble induced mixing and dispersion: experiments and CFD modeling
F. Augier¹, C. Plais¹, E. Almeras^{1,2}, F. Risso² and V. Roig²
1. IFP Energies nouvelles, Solaize, France.
2. IMFT. University of Toulouse and CRNS, Toulouse, France.

9:30 pm Computing dissolved oxygen profiles in aerobic fermenters
G. T. Benz¹, A. Kulkarni², G. R. Kasat² and D. Vedapuri²
1. Benz Technology International, Inc, Clarksville, OH, USA
2. Tridiagonal Solutions Inc., San Antonio, TX, USA.

9:55 pm Social hour

TUESDAY MORNING – MIXING IN MULTIPHASE SYSTEMS

Chairs: **F. Visscher, SABIC Technology and Innovation, Geleen, The Netherlands.**
R. Weetman, Retired.

- 8:00 am Experimental investigation of the formation of extremely fine droplets in water-bitumen mixtures
R. Sonthalia¹, S. Ng² and A. Ramachandran¹
1. Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, ON, Canada.
2. Research and Development Center, Syncrude Canada Ltd., Edmonton, AB, Canada.
- 8:25 am Development of a multi-scale model for the design and scale-up of gas/liquid stirred tanks reactors
H. Bashiri, F. Bertrand and J. Chaouki
École Polytechnique de Montréal, Montréal, QC, Canada.
- 8:50 am Student Award Finalist: Impact of mixing on emulsion polymerization
S.F. Roudsari, F. Ein-Mozaffari and R. Dhib
Department of Chemical Engineering, Ryerson University, Toronto, ON, Canada.
- 9:15 am Prediction of drop size in agitated liquid-liquid systems: from the macro-scale to the sub-Kolmogorov regime
R. V. Calabrese
University of Maryland, College Park, MD, USA.
- 9:40 am Break
- 10:10 am Plenary: High energy mixing of fluids with rotating devices
C. J. Brown
Maelstrom APT Ltd., Glossop, UK.
- 10:50 am Student Award Finalist: Numerical study of turbulent liquid-liquid dispersion
A. E. Komrakova¹, D. Eskin², and J. Derksen^{1,3}
1. Chemical and Materials Engineering, University of Alberta, Edmonton, AB, Canada.
2. Schlumberger DBR Technology Center, Edmonton, AB, Canada.
3. School of Engineering, University of Aberdeen, Aberdeen, Scotland.
- 11:15 am High-efficient mixing solutions for emulsion polymerization
W. Himmelsbach, N. Rohn and B. Nienhaus
Ekato RMT, Schopfheim, Germany.
- 11:40 am Novel mixer for dynamically-enhanced separation of organic-aqueous systems
K. Kar¹, K. Mosner¹, R. Cope² and M. Somasi¹
1. The Dow Chemical Company, Midland, MI, USA.
2. Eli Lilly and Co., Indianapolis, IN, USA.
- 12:05 pm Lunch

TUESDAY AFTERNOON

- 2:00 pm Panel discussion on Scale-Up
Speakers to be confirmed.
Moderated by A. W. Etchells III, Retired.
- 4:00 pm Social hour and Poster session

TUESDAY EVENING – SOLIDS SUSPENSION IN AGITATED VESSELS

Chairs: **L. J. Sierra, Merck, Sharpe and Dohme, Rahway, NJ, USA.**
R. F. Cope, Eli Lilly and Company, Indianapolis, IN, USA.

- 7:00 pm Just suspended speed for solids in mechanically agitated tanks: effect of particle shape and size
A. W. Etchells III¹ and R. P. Hesketh²
1. Retired
2. Department of Chemical Engineering, Rowan University, Glassboro, NJ, USA.
- 7:25 pm Correlations for prediction of solids suspension in stirred tanks: limitations of Zwietering correlation and path forward
I. Ayranci and S. M. Kresta
Chemical and Materials Engineering, University of Alberta, Edmonton, AB, Canada.
- 7:50 pm Impeller power draw in liquid-solid systems
K. J. Myers¹, T. Bao¹, E. E. Janz² and R. J. Strong²
1. Department of Chemical Engineering, University of Dayton, Dayton, OH, USA.
2. Chemineer, Dayton, OH, USA.
- 8:15 pm Break
- 8:40 pm On the effect of concentration, clearance and impeller type on the cloud height and distribution of solids in stirred vessels
D. A. R. Brown
The British Hydromechanics Research Group, Cranfield, UK.
- 9:05 pm Solids suspension scale-up: results from large scale experiments
R. Jacques¹, T. Post² and K. Johnson³
1. Envirequip, Glen Robertson, ON, Canada.
2. Post Mixing Optimization and Solutions LLC, Pittsford, NY, USA.
3. Independent Consultant, Findlay, OH, USA.
- 9:30 pm Optimization of impeller placement and geometry in nonstandard slurry mixing vessels using parametric CFD
J. Walker
The Dow Chemical Company, Midland, MI, USA.
- 9:55 pm Social hour

WEDNESDAY MORNING – MIXING OF COMPLEX FLUIDS

Chairs: **T. A. Simpson, DuPont Engineering, Wilmington, DE, USA.**
A. W. Nienow, Retired.

- 8:00 am Student Award Finalist: Tomography images to analyze the deformation of the cavern in the continuous-flow mixing of non-Newtonian fluids
 D. Patel, F. Ein-Mozaffari and M. Mehrvar
 Department of Chemical Engineering, Ryerson University, Toronto, ON, Canada.
- 8:25 am The use of butterfly impellers for the industrial mixing of viscoelastic fluids
 J. Ramsey¹, M. Simmons¹, A. Ingram¹, A. Tharakan² and E H. Stitt²
 1. School of Chemical Engineering, University of Birmingham, Birmingham, UK.
 2. Johnson Matthey Technology Center Chilton, Billingham, UK.
- 8:50 am Mixing time and power consumption of helical double-ribbon and segmented curved ribbon impellers in cohesive food powders
 I. Gijón-Arreortúa and A. Tecante
 Universidad Nacional Autónoma de México, Ciudad Universitaria, México.
- 9:15 am Continuous low-frequency acoustic mixing of pastes and powders
 P. Lucon¹, L. C. Farrar¹, J. Lucon² and S. Coguil²
 1. Resodyn Acoustic Mixers, Butte, MT, USA
 2. Resodyn Corporation, Butte MT, USA.
- 9:40 am Break
- 10:10 am Plenary: Magnetic resonance imaging (MRI) to assess rheology and mixing in process applications
 K. McCarthy¹, E. Tozzi² and M. McCarthy^{1,2}
 1. University of California, Davis, USA.
 2. Aspect Imaging, Shoham, Israel.
- 10:50 am Area distribution and individual striation methods to identify mixing performance via an optical method (PLIF) for the blending of non-Newtonian fluids in static mixer
 F. Alberini¹, M. Simmons¹ and A. Ingram¹ and E. H. Stitt²
 1. School of Chemical Engineering, University of Birmingham, Birmingham, UK.
 2. Johnson Matthey Technology Center Chilton, Billingham, UK.
- 11:15 am Characterization of flow and mixing of complex fluids in continuous processing equipment using PEPT
 O. Mihailova^{1,2}, S. Bakalis², A. Ingram², D. O'Sullivan¹, W. Broeckx¹ and C. Jones¹
 1. Procter & Gamble Brussels, Brussels, Belgium.
 2. School of Chemical Engineering, University of Birmingham, Birmingham, UK.
- 11:40 am Recognizing the 25 most bottom-line economical fluid mixing developments
 J. B. Fasano¹, K. J. Myers², G. K. Patterson¹ and W. R. Penney³
 1. Retired.
 2. Department of Chemical Engineering, University of Dayton, Dayton, OH, USA.
 3. Ralph E. Martin Department of Chemical Engineering, University of Arkansas, Fayetteville, AR, USA.
- 12:05 pm Lunch

WEDNESDAY AFTERNOON

- 4:00 pm Social hour and Poster session

WEDNESDAY EVENING – MEASUREMENTS AND MODELLING

Co-chairs: **L. Tavlarides, Syracuse University, Syracuse, NY, USA.**
 T. M. Hutchinson, Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.

7:00 pm **Measuring local fluid ages in stirred tanks with planar laser-induced fluorescence (PLIF)**

A. Hawryluk
NOVA Chemicals Research & Technology Centre, Calgary, Canada.

7:25 pm **Obtaining the Nusselt equation of a stirred tank heated with helical coils with the use of CFD**

R. J. Prada and J. R. Nunhez
Chemical Engineering Faculty, State University of Campinas, Campinas, Brazil.

7:50 pm **Measurement of radial mixing in a Karr extraction column**

M. D. Cloeter¹, T. Young¹, S. Kumar² and G. Worley³
1. The Dow Chemical Company, Freeport, TX, USA.
2. Dow International Private Ltd., Mumbai, India.
3. The Dow Chemical Company, Deer Park, TX, USA.

8 :15 pm **Break**

8:40 pm **Hydrodynamic regimes and mixing time in a stirred vessel filled at different liquid levels**

S. Motamedvaziri and P. M. Armenante
New Jersey Institute of Technology, Newark, NJ, USA.

9:05 pm **Structure of turbulent velocity field in the discharge stream from a standard Rushton turbine impeller**

B. Kysela¹, J. Konfrst¹, I. Fort² and Z. Chara¹
1. Institute of Hydrodynamics AS CR, Prague, Czech Republic.
2. Department of Process Engineering, Czech Technical University in Prague, Prague, Czech Republic.

9:30 pm **Residence time distribution of liquid flow in tubular reactors equipped with screen-type static mixers**

K. A. Hweji and F. Azizi
American University of Beirut, Beirut, Lebanon.

9:55 pm **Social hour**

THURSDAY MORNING – NOVEL TECHNIQUES

Chairs: **D. Dickey, Mixtech, Coppell, TX, USA.**
D. Grutmacher, Pro Quip Inc., Macedonia, OH, USA.

- 8:00 am Analysis of local multiphase dispersions in a pilot scale stirred tank using a high-performance red light source probe
 A. Holguin-Salas, G. Corkidi and E. Galindo
 Universidad Nacional Autónoma de México, Ciudad Universitaria, México.
- 8:25 am Mixing times, competitive reactions, and scale-up
 G. K. Patterson and J. B. Fasano
 Retired.
- 8:50 am Mixing in oil storage tanks: BS & W and blending
 J. G. Giacomelli, R. W. Higbee, C. Hastings and R. K. Grenville
 Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.
- 9:15 am Impact of agitation on the growth rate of CO₂ gas hydrates in a semi-batch stirred tank reactor
 S. Douïeb¹, L. Fradette¹, F. Bertrand¹ and B. Haut²
 1. URPEI, Department of Chemical Engineering, École Polytechnique de Montréal, Montréal, Canada
 2. TIPS, Université Libre de Bruxelles, Université Libre de Bruxelles, Brussels, Belgium.
- 9:40 am Break
- 10:10 am Plenary: Mixing in minerals and metallurgical industries
 S. Miskovic
 University of Utah, Salt Lake City, UT, USA.
- 10:50 am Investigation of cavitator technology for mixing applications
 A. Strand
 SPX Flow Industrial (Lightnin), Rochester, NY, USA.
- 11:15 am Symmetry breaking and hysteresis of the averaged flow field in stirred tank reactors with radial impellers
 R. Ben-Nun, A. Marmur and M. Sheintuch
 Department of Chemical Engineering, Technion – Israel Institute of Technology, Haifa, Israel.
- 11 :40 am Introduction into the classification of patents in the field of mixing
 B. Krasenbrink and R. Real Cabrera
 European Patent Office, Rijswijk, Netherlands.
- 12 :05 pm Lunch

THURSDAY AFTERNOON

4:00 pm Social hour and Poster session

THURSDAY EVENING

7:00 pm NAMF Banquet

FRIDAY MORNING

Breakfast and departure

POSTERS

1. **Solids suspension and mass transfer in agitated vessels**
R. K. Grenville
Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.
2. **Mixing for anoxic denitrification in waste water treatment plants**
J. Barnes, J. G. Giacomelli, T. M. Hutchinson, R. W. Higbee and R. K. Grenville
Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.
3. **Mixing in waste water lagoons at paper mills: application of CFD**
B. Wu and M.R. Moseley
Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.
4. **Application of low-frequency acoustic mixing as a continuous chemical reactor**
P. Lucon¹, J. Lucon², S. Coguill² and L. C. Farrar¹
1. Resodyn Acoustic Mixers, Butte, MT, USA
2. Resodyn Corporation, Butte MT, USA.
5. **Universal batch mixing platform**
P. Lucon and L. C. Farrar
Resodyn Acoustic Mixers, Butte, MT, USA.
6. **Impeller power draw in concentrated biomass slurry**
J. Deng¹, K. J. Myers¹, E. E. Janz² and R. J. Strong²
1. Department of Chemical Engineering, University of Dayton, Dayton, OH, USA.
2. Chemineer, Dayton, OH, USA.
7. **Impeller power draw across the full Reynolds number spectrum**
Z. Ma¹, K. J. Myers¹, E. E. Janz² and R. J. Strong²
1. Department of Chemical Engineering, University of Dayton, Dayton, OH, USA.
2. Chemineer, Dayton, OH, USA.
8. **Simulating fast chemical reactions and mixing with random coalescence-dispersion modeling**
G. K. Patterson
Retired.
9. **Impact of mixing on demulsifier performance in a bitumen clarification process**
J. Y. Chong, S. Leo, M. B. Machado, S. Bhattacharya, S. Ng and S. M. Kresta
Chemical and Materials Engineering, University of Alberta, Edmonton, AB, Canada.
10. **Taylor dispersion of a passive tracer in the pressure-driven flow of a concentrated suspension of rigid, non-colloidal spheres**
A. Ramachandran
Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, ON, Canada.
11. **Development of a new horizontal flow accelerating device for biological wastewater treatment plant**
M. Höfken, E. Riess-Gonzalez and W. Steidl
INVENT Environmental Technologies Inc., Cedar Grove, NJ, USA.
12. **Low viscosity blending performance for multiple hydrofoil impellers in tall vessels**
R. O. Kehn, M. Powell and A. Strand
SPX Flow Industrial (Lightnin), Rochester, NY, USA.
13. **Mixing in the NETmix reactor: heat and mass transfer modelling**
C. P. Fonte¹, M. F. Costa², M. M. Dias² and J. C. B. Lopes²
1. The British Hydromechanics Research Group, Cranfield, UK.
2. Laboratory of Separation and Reaction Engineering, Faculty of Engineering, University of Porto, Portugal.
14. **Oxygen transfer rates are not always determined merely by power/mass and superficial gas velocity: a fermentation process example of an Eli Lilly and Co. recombinant *E. coli* process**
B. R. Allen
Eli Lilly and Company, Indianapolis, IN, USA.
15. **Mixing of viscous liquids and large concentrations of spherical particles in stirred tanks**
M. Lassaigne, B. Blais, I. Ayranci, L. Fradette and F. Bertrand
Department of Chemical Engineering, Polytechnique Montréal, Montréal, QC, Canada.
16. **Mass transfer in lab scale fermenters: predicting scale-up**
J. Birmingham¹, J. G. Giacomelli² and R. K. Grenville^{1,2}
1. Department of Chemical and Biomolecular Engineering, University of Delaware, Newark, DE, USA.
2. Philadelphia Mixing Solutions Ltd., Palmyra, PA, USA.

17. **Student Award Runner-Up: Hydrodynamic characterization and foam production of three designs of Mexican molinillos (beaters) for preparing chocolate beverages**
 - A. Holguín-Salas,
Instituto de Biotecnología, Universidad Nacional Autónoma de México (UNAM), Cuernavaca, Morelos, México.
18. **Student Award Runner-Up: Turbulent mixing in a microchannel at very low Reynolds number**
 - W. Zhao¹, F. Yang¹ and G. Wang^{1,2}
 1. Department of Mechanical Engineering, University of South Carolina, Columbia, SC, USA.
 2. Biomedical Engineering Program, University of South Carolina, Columbia, SC, USA.