# MIXING XVII

## 17th BIENNIAL NORTH AMERICAN MIXING CONFERENCE

AUGUST 15-20, 1999
THE BANFF CENTRE FOR CONFERENCES
BANFF, ALBERTA, CANADA

Sponsored by

**NAMF**

**North American Mixing Forum of the**
**American Institute of Chemical Engineers**

Co-sponsor: Working Party on Mixing of the
European Federation of Chemical Engineering

**Chair: Philip E. Wood, McMaster University (Canada)**

***Preliminary Program – July 27, 1999***

## *Sunday August 15, 1999*

3:00 P.M. to 9:00 P.M. *REGISTRATION AND CHECK-IN*

5:30 P.M. to 7:30 P.M. *DINNER*

9:00 P.M. to 11:00 P.M. *RECEPTION*

### *Monday August 16, 1999*

7:00 A.M. to 8:25 A.M. *BREAKFAST*

8:25 A.M. to 8:30 A.M. *INTRODUCTION – P.E. Wood*

8:30 A.M. to 12 Noon *TECHNICAL SESSION*

## 1. Industrial Mixing Practices

Chairs: Dave Dickey, Mixtech and Midey Chang-Maten, Rohm & Haas

1.1 **Mixing in the Pulp and Paper Industry**
Chad Bennington, University of British Columbia (Canada)

1.2 **Application of Multi-Stage Mixing Tanks in Reacting and Non-Reacting Systems**

Ramesh Hemrajani, Milind Ajinkya, Exxon Research and Engineering Company (USA)

1.3 **Industrial Mixing Problems - Causes and Solutions**
Doug Leng, Leng Associates (USA)

1.4 **Exploring VisiMix as a Productivity Tool for the Analysis, Scale-up and Design of Mixing Processes**
Victor Atiemo-Obeng, The Dow Chemical Co. (USA)

1.5 **Scale-up Behaviour of the Drop Size Distribution of Liquid/Liquid Dispersions in the Stirred Vessels at High (50%) Dispersed Phase Volume Fractions**
Gert Colenbrander, Shell Global Solutions, Amsterdam

1.6 **Motion of Neutrally Buoyant Particles in Stirred Vessels: CARPT Experiments and CFD Simulations**
V.V. Ranade, National Chemical Laboratory (India), A. Rammohan, A. Kemoun, M.H. AlBDahhan and M.P. Dudukovic, Washington University (USA)

1.7 **The Scale-Up of Multi Stage Mixing Columns from Batch Multi Phase Data**
James Oldshue, Oldshue Technologies (USA)

1.8 **Mixing Technology at Rohm and Haas - A Key Technical Capability**
Donald Koestler, Rohm and Haas (USA)

12:00 Noon to 1:30 P.M. *LUNCH*

5:00 P.M. to 6:00 P.M. *SOCIAL HOUR*

5:30 P.M. to 7:00 P.M. *DINNER*

7:00 P.M. to 10:00 P.M. *TECHNICAL SESSION*

## 2. Mixing in Stirred Tanks

Chairs: Richard Calabrese, University of Maryland and Victor Atiemo-Obeng, Dow

2.1 **Mixing Characteristics of Full Scale 81 inch Diameter Modified Smith and Rushton Turbines**
Richard Houk, Gary Hodenius and Thomas Post, LIGHTNIN (USA)

2.2 **Dominant Velocity Signal Characteristics for Various Impellers and Their Effect on Turbulence Measurements**
Biljana Grgic, Vesselina Roussinova and Suzanne Kresta, University of Alberta (Canada)

2.3 **The Mean Flow in the Discharge of Axial Flow Impellers and its Effect on Mixing Processes**

S. Ruszkowski, Proctor & Gamble, M.E. Musgrove, BHR Group Ltd.

2.4 **An Improved Maxflo Impeller**
Julian Fasano and Mark Reeder, Chemineer (USA)

2.5 **Experimental Study of Trailing Vortices Around Impeller Blades**
Marcus Schafer, Klaus Wechsler and Franz Durst, University of Erlangen (Germany)

2.6 **Characterization of Single Phase Flow in a Stirred Tank Using Computer Automated Radioactive Particle Tracking (CARPT)**
A. Kemoun, A. Rammohan, M.H. Al-Dahhan and M.P. Dudukovic, Washington University, (USA)

2.7 **Production Scale Flow Measurements Using Ultrasonic Doppler Velocimetry**
Marcus Hofken, Walter Steidl , Invent Umwelt-und Verfahrenstechnik GmbH & Co. (Germany), Marcus Schafer, LSTM-Erlangen (Germany), and Jukka Koskinen, NESTE Engineering Oy (Finland)

2.8 **Non-Newtonian Mixing with Large D/T Counterflow Impeller**
Wojciech Wyczalkowski, Philadelphia Mixers, (USA)

10:00 P.M. to 11:00 P.M. *SOCIAL HOUR*

## *Tuesday August 17, 1999*

7:00 A.M. to 8:30 A.M. *BREAKFAST*

8:30 A.M. TO 12:00 A.M. *TECHNICAL SESSION*

10:10 A.M. to 10:40 A.M. *COFFEE BREAK*

## 3. Mixing with Chemical Reaction

Chairs: Bruce Nauman, R.P.I. and Roy Penney, University of Arkansas

3.1 **Turbulent Mixer Model With Application to Chemical Reaction and Precipitation Processes**
Jerzy Baldyga, Marek Henczka, Lukascz Makowski and Wojciech Orciuch Warsaw University of Technology (Poland)

3.2 **Effects of Changed Mixing and Heat transfer Upon Scale-Up on the Yield of Products for Exothermic, Complex Reactions**
Gary Patterson, University of Missouri-Rolla (USA)

3.3 **Analysis of MicroMixing in Pilot Scale Stirred Tank Reactors Using the Third Bourne Reaction**

A. Fine, M. Hobbs, J. Lowinger, M. Midler, R. Osifchin and C. Starbuck, Merck & Co. (USA)

3.4 **Mixing and Reaction in a baffled Stirred Tank Reactor: Comparison Between Experiments and a Novel Micromixing-Based CFD Model**
Otute Akiti and Piero Armenante, New Jersey Institute of Technology (USA)

3.5 **Bridging Chemistry and Mixing Time Scales in Reacting Flow Simulations**
P.J. Smith and J.P. Spinti, University of Utah (USA)

3.6 **Macro-mixing in the Drais-Reactor under Turbulent Conditions**
G.J.S. van der Gulik, J.G. Wijers and J.T.F. Keurentjes, Einhoven University of Technology (The Netherlands)

3.7 **Micromixing in the Liquid Phase of a Gas-Liquid Dispersion**
John Bourne, Retired (England)

3.8 **CFD Modelling of Fast Two-Phase Exothermic Reaction Systems in Laboratory and Production Scale Vessels, with Experimental Validation**
Kari I. Keskinen and Jukka Koskinen, Neste Engineering Oy (Finland) and Mark Brennan and Joe Hannon, Performance Fluid Dynamics (Ireland)

3.9 **Turbulent Mixing and Chemical Reactions in an Ideal Tubular Reactor**
Robert S. Brodkey, Ohio State University USA) and Suzanne Kresta, University of Alberta (Canada)

12:00 Noon to 1:30 P.M. *LUNCH*

5:00 P.M. to 6:00 P.M. *SOCIAL HOUR*

5:30 P.M. to 7:00 P.M. *DINNER*

7:00 P.M. TO 10:00 P.M. *TECHNICAL SESSION*

## 4. Computational Fluid Dynamics and Mixing

Chairs: Piero Armenante, NJIT and Muthanna Al-Dahhan, Washington University

4.1 **Assessment of Lagrangian Particle Tracking of CFD Results to Predict Blending Times in Turbulent Mixing**
Richard D. LaRoche, DuPont Engineering Technology and Minye Liu Procter & Gamble

4.2 **Application of CFD to the Estimation of Secondary Phase Size Distributions: Approaches and Implications for Reactor Design**
David H. Wei, BHR Group Ltd., S. Lo, CFX International, Simon E. Leefe, BHR Group Ltd., (Great Britain)

4.3 **Accurate, Robust, High Performance CFD Using the Galerkin/Least-Squares Finite Element Method**
Farzin Shakib, Acusim Software Inc., Keith E. Johnson and Henry F. Fong, HAL Computer Systems (A Fujitsu Co.), (USA)

4.4 **Large-Eddy Simulations with Lattice-Boltzmann Discretization for Mixing Flows**
Jos Derksen and Harry Van de Akker, Delft University of Technology (The Netherlands)

4.5 **Construction of Data Base of Three Dimensional Velocities in an Agitated Vessel**
Yoshito Tanaka, Shigeo Nishimura and Yushi Hirata, Osaka University, (Japan)

4.6 **Application of Population Balance to CFD Modelling of Bubbly Flow Via the MUSIG Model**
Simon Lo, AEA Technology Plc., (U.K.)

4.7 **Mixing Time: A Computational Fluid Mixing Approach**
Lanre M. Oshinowo, Andre Bakker, Elizabeth M. Marshall, Fluent Inc., U.S.A.

4.8 **Effects of Feed Time, Feed Position, Viscosity and Scale-Up on fast Complex Reactions: CFD with Experimental Verification**
A. Bird, Steve Hearn, Performance Fluid Dynamics Ltd and E. Marshall, W. Zhou, Fluent Inc.

## *Wednesday August 18, 1999*

7:00 A.M. to 8:30 A.M. *BREAKFAST*

8:30 A.M. to 12:00 Noon *TECHNICAL SESSION*

## 5. High Shear Mixing

Chairs: Chad Bennington, U.B.C. and Julian Fasano, Chemineer

5.1 **Assessment of Rotor-Stator Mixing Devices**
Richard V. Calabrese, University of Maryland

5.2 **Power Draw Characteristics of a High-Shear Homogenizer**
Kevin J. Myers, University of Dayton, Mark F. Reeder and Geoffrey Daly, Chemineer Inc.

5.3 **Hydrodynamics Characterization of Coaxial Mixers for Solid-Liquid Mixing**
F. Thibault and P.A. Tanguy, Ecole Polytechnique, E. Brito-De La Fuente, Universidad Nacional Autonoma de Mexico

5.4 **The Influence of Impeller Type on Mean Drop Size and Drop Size Distribution in an Agitated Vessel**
A.W. Nienow, University of Birmingham UK, A. Bakker, Chemineer Inc. USA

## 6. Solids Suspension

Chairs: Chad Bennington, U.B.C. and Julian Fasano, Chemineer

6.1 **Suspension of Light Particles in Stirred Vessels**
Gul Ozcan-Taskin, BHR Group Ltd., Geoff McGrath, Intevep S.A.

6.2 **Two and Three-phase Solids Suspension Using Hollow Bladed Impellers**
Darren Nelson and N. Ahmed, The University of Newcastle

6.3 **Mixing of Three-phase Systems at High Solids Content (up to 40% w/w) Using Radial and Axial Flow Impellers**
W. Bujalski, The University of Birmingham, K. Takenaka, Yamagata University, G. Ciervo, University of Rome

6.4 **Effect of Liquid Height on Solid Suspension in Mechanically Agitated Vessel**
Maddalena Antonucci, Sergio Di Cave and Barbara Mazzarotta, Universita degli Studi di Roma, La Sapienza, Italy, Piero M. Armenanate, New Jersey Institute of Technology, U.S.A.

12:00 Noon to 1:30 P.M. *LUNCH*

2:00 P.M. to 6:00 P.M. *POSTER SESSION*

## 7. Posters

Chairs: Ramesh Hemrajani, Exxon and Philip Wood, McMaster University

7.1 **Attrition in Stirred Tanks: Cause and Effects**
A.W. Etchells and W.N. Ford**,** Dupont Engineering & Technology

7.2 **Cavern Growth and Flow Behaviour in Mixing Non-Newtonian Fluids with Yield Stress**
Takaya Nagafune and Yushi Hirata, Osaka University, Japan

7.3 **Mixing Performance by Reciprocating a Disk in a Cylindrical Vessel**
Yoshiyuki Komoda, Yoshiro Inoue and Yushi Hirata, Osaka University, Japan

7.4 **Reaction and Diffusion in a Lamellar Structure: The Effect of Lammellar Arrangement on Yield**
E.P.L. Roberts, M.J. Clifford and S.M. Cox, University of Nottingham

7.5 **Electric-Field Effects on Fluids with Applications in Oxidation of Organic**

**Compounds**
Costas Tsouris, Won-Tae Shin and Sotira Yiacoumi, Georgia Institute of Technology

7.6 **Investigation of Scale Parameters in Solid-Liquid Mixng Tank with Free Jet Flow Agitators**
Hanna Gladki, ITT Flygt Corp., Michael R. Poirier and Philip O. Rodwell, Westinghouse Savannah River Co., Mike R. Powell, Pacific Northwest National Laboratory

7.7 **Effects of Turbulent Mechanical Stresses on Animal and Plant Cells**
Jerzy Baldyga, Ryszard Pohorecki, Wojciech Golis, Adam Ryszczuk, Warsaw University of Technology

7.8 **Electrohydrodynamic Mixing and Reaction in Multiphase and Miscible Systems**
David W. DePaoli, Costas Tsouris and Michael Z.-C. Hu, Oak Ridge National Laboratory

7.9

7.10 **The Advantage of Up-Pumping A340s Over Other Conventional Gas Liquid Contacting Impellers**
Barb Noce, Thomas Post, Greg Ripley and Ron Weetman, Lightnin

7.11 **The Third-Generation of Gas Dispersion Impellers**
Mark F. Reeder and Julian B. Fasano, Chemineer Inc., Aaron J. Thomas and Kevin J. Myers, University of Dayton

7.12 **Heat Transfer Model for Externally Turbulized Boundary Layers Used in Vismix Sofware**
Michael A. Reyz, Leonid N. Braginsky, Yury V. Kokotov and Yury Z. Nekhamkin, VisiMix Ltd., Isreal

7.13 **A New Software Tool for the Selection and Design of Mixers for Stirred Vessels**
Marcus Hofken, Walter Steidl, Peter Meiler, INVENT Umwelt-und Verfahrenstechnik GmbH & Co.

7.14 **About Micromixing Phenomena in Stirred Vessels**
Marcus Hofken, Walter Steidl, Ralf Simon, INVENT Umwelt-und Verfahrenstechnik GmbH & Co.

7.15 **A New Model for Mixing in Circulatory Flows**
R.B.H. Tan and M. Hari, National University of Singapore

7.16 **Sliding Mesh Simulation of the Flow in a Rotor-Stator Mixer**
Richard V. Calabrese, Ved P. Mishra, Samuel Epee-Bounya and Karl R. Kevala, University of Maryland, and Lanre Oshinowo, Fluent Inc.

7.17 **Hydrodynamics of Three-phase Mixing in Course Particle Flotation**
S. Hui and N. Ahmed, The University of Newcastle

7.18 **The Prediction of Solids Cloud Height Within a Stirred Tank**
Kevin J. Bittorf and Suzanne M. Kresta, University of Alberta

7.19 **Analysis of Macro-Instabilities in a Stirred Tank Reactor (STR) Agitated with Pitched Blade Turbine**
Vesselina Roussinova and Suzanne M. Kresta, University of Alberta

7.20 **Mixing Times in Vapour Generating Gas Liquid Reactors**
John M. Smith, C. Ruh, Z. Gao and Donglin Zhao, University of Surrey

7.21 **Power Demand and Flooding in Sparged Boiling Reactors**
John M. Smith and Z. Gao, University of Surrey

7.22 **Liquid Phase Mixing in Boiling and Sparged Reactors**
D. Zhao, Z. Gao, C. Ruh and John M. Smith, University of Surrey

7.23 **Dispersion and Coalescence in Multi-Phase Industrial Streams: The Role of Dynamic Interfacial Characteristics**
A.M. Al Taweel and Y. Xue, Dalhousie University, J. Yan, W.M. Kellog, A. Ongiro, Bantrel Engineering

7.24 **Visualization of the Flow in Stirred Vessels Equipped with Rushton Impellers: Origin and Interaction of the Trailing Vortices@**
A. Kemoun, F. Lusseyran, J. Mallet and M. Mahouast, LEMTA-CNRS (France)

7.25 **Use of Mixing Sensitive Chemical Reactions to Study Mixing in Dispersed Systems**
C.P.J. Bennington and J.P. Mmbaga, University of British Columbia (Canada)

7.26 **Comparison of Turbulence Models in CFD Predictions of Flow Patterns and Power Draw in Stirred Tanks**
Liz Marshall and Lanre Oshinowo, Fluent Inc and Ronald Weetman, Lightnin (USA)

7.27 **Drop Size Distribution and Power Draw in a Batch Rotor-Stator Mixer**
Richard V. Calabrese and Michael K. Francis, University of Maryland

7.28 **Simulation of the Population Balances for Liquid-Liquid Systems in a Nonideal Stirred Tank**
Ville Alopaeus, Jukka Koskinen and Kari I. Keskinen, Neste Engineering Oy (Finland)

7.29 **Validation of CFD Modeling in a Production Scale Stirred Reactor Against UDA**

**and Conductivity Measurements**
J. Majander, VTT Energy; J. Koskinen, K. Keskinen, Neste Engineering Oy (Finland); W. Steidl, M. Hofken, Invent Umwelt-Und Verfahrenstechnik GmbH & Co; M. Schafer, LSTM-Erlangen (Germany

7.30 **The Use of Solids Suspension Performance in High-Efficiency Impeller Development**
Jeff Spurgeon and Kevin J. Myers, University of Dayton

7.31 **Novel Spatially-Resolved Reactive Diagnostics for Mixing**
C.W. Lipp, L.A. Melton, University of Texas at Dallas, R.M. Larkins, S. Sen and R.D. Spradling, Dow Chemical Co., U.S.A.

7.32 **Measured Vapour Hold-Up Profiles in a 51 Cubic Metre Boiling Stirred Reactor**
Gert Colenbrander, Shell Global Solutions, Amsterdam

7.33 **Reaction Inhibitor Mixing to Prevent a Runaway in a Stirred Reactor After Loss Agitation**
Gert Colenbrander, Shell Global Solutions, Amsterdam

5:30 P.M. to 7:00 P.M. *DINNER*

7:00 P.M. TO 10:00 P.M. *TECHNICAL SESSION*

## 8. Gas/Liquid Systems

Chairs: Geoff Evans, University of Newcastle and Alvin Nienow Birmingham

8.1 **Prediction of Two-Phase Phenomena Near Impeller Blades**
J.C. Middleton and A. Eaglesham, ICI Technology

8.2 **Mass Transfer and Void Distribution in Mechanically Agitated Gas-Liquid Reactors**
John M. Smith and Zhengming Gao, University of Surrey

8.3 **Gas Dispersion and Aeration in Impeller Stirred Vessels**
S. Manning and G.M. Evans, University of Newcastle

8.4 **Effective Viscosity in Two-Phase Gas-Liquid Flows**
A. Lapin, T. Paaschen, K. Junghans and A. Luebbert, Martin-Luther Universitaet

8.5 **Effect of Interfacial Characteristics and Sparger Performance on Axial Mixing in Bubble Columns**
A.M. Al Taweel and M. Ramadan, Dalhousie University, R. Moharram and T.A. Hassan, Al-Azhar University

8.6 **Investigation of Liquid Mixing in Churn-Turbulent Bubble Columns Using Conductivity Probes**
P. Gupta, B.C. Ong, M.H. Al-Dahhan and M.P. Dudukovic, Washington University

8.7 **A New Vortex Mixer for Turbulent Flow**
Shaffiq Jaffer, Koch-Glitsch Inc. U.S.A.

8.8 **Gas Gas Mixing with the Kenics Hev Mixer: Inlet and Outlet Effects**
A.W. Etchells, DuPont Engineering Technology, R. Wadley, BHRG, Julian Fasano, Chemineer-Kenics

## *Thursday August 19, 1999*

7:00 A.M. to 8:00 A.M. *BREAKFAST*

8:00 A.M. to 12 Noon *TECHNICAL SESSION (note early start)*

## 9. Mixing Fundamentals

Chairs: Shaffiq Jaffer, Koch and Kathleen Barton, Monsanto-Searle

9.1 **Application of a New Interfacial Area Transport Equation to Predict Interfacial Area in Several Flow Geometries**
Richard Long, New Mexico State University, Steve Yarbro and Paul Reimus, Los Alamos
National Laboratory

9.2 **Micromixing and Reaction in Chaotic Fluid Flows**
Michael J. Clifford, The University of Nottingham, E.P.L.Roberts, UMIST

9.3 **The Mechanism of Laminar Mixing in Stirred Tanks**
F.J. Muzzio, M.M. Alvarez-Hernandez, T. Shinbrot, J. Zalc, Rutgers University

9.4 **Numerical Simulation of Laminar Mixing of Highly Viscous Media**
Regina Schlegel and Marc Wehrli, Sulzer Innotec, Markus Fleischli, Sulzer Chemtech

9.5 **Heat Transfer Analysis in VisiMix 2000 Laminar**
Michael A. Reyz, Leonid N. Braginsky, Yury V. Kokotov and Yury Z. Nekhamkin, VisiMix Ltd.

9.6 **Inline Motionless Mixers: History, Fundamentals & Application Uses**
Mughis Naqvi, TAH Industries

9.7 **The Relationship Between Turbulent Blend Time and Momentum Generated by Impellers and Jet Mixers**

R.K. Grenville, DuPont Engineering Technology U.S.A., M.E. Musgrove, British Hydromechanics Research Group Ltd. U.K., N.S.J. Fawcett, Yorkshire Water Services, U.K.

9.8 **Novel BEM Simulation of Mixing in Polymer Flows Including Non-Linear Effects**
Antoine C. Rios and Tim A. Osswald, University of Wisconsin-Madison

9.9 **The Evolution of Morphology During the Mixing of Immiscible Polymer Blends**
Michael J. Solomon, Wahab Almusallam and Ronald G. Larson, University of Michigan

9.10 **The Evolutionof Morphology During the Mixing of Immiscible Polymer Blends**
Bruce Nauman, RPI, (USA)

9.11 **Novel Phenomena in Liquid-Liquid Systems Under the Influence of Electric Fields**
Costas Tsouris and Junhang Dong, Oak Ridge National Laboratory

12 Noon to 1:30 P.M. *LUNCH*

5:00 P.M. to 6:00 P.M. *SOCIAL HOUR*

6:00 P.M. to 8:00 P.M. *NAMF BANQUET AND BUSINESS MEETING*

8:00 P.M. to 10:00 P.M. *TECHNICAL SESSION*

## **10**. Experimental Methods and Validation

Chairs: Suzanne Kresta, University of Alberta and Richard Grenville, Dupont

10.1

10.2 **An Experimental Study of Feed Stream Mixing in Agitated Vessels**
Iris Verschuren, Johan Wijers and Jos Keurentjes, Eindhoven University of Technology

10.3 **On Turbulent Mixing in a Confined Mixing Layer in a Pipe**
G.R. Wang and H.E. Fiedler, Hermann-Foettinger-Institut for Fluid Mechanics, Technical University of Berlin

10.4 **Using an FBRM Probe to Monitor Dispersion Progress**
J.H. Fox, 3M Company

10.5 **On the Transition from Homogenous to Heterogenous Flow in a Gassed Stirred Vessel** Klaus M. Gezork, University of Birmingham (U.K.)

10.6 **Acoustic Probe for Solid/Gas/Liquid Suspensions**
M. Norato, P. Spelt, M. Greenwood, A. Sangani, L. Tavlaridis, Syracuse University

10:00 P.M. to 11:00 P.M. *SOCIAL HOUR*

## *Friday August 20, 1999*

7:00 A.M. to 8:00 A.M. *BREAKFAST*

8:00 A.M. to 12 Noon *TECHNICAL SESSION*

### 11. Biological, Pharmaceutical & Non-Newtonian Mixing

Chairs: Arthur Etchells, DuPont and Edmundo Brito-De La Fuente, Universidad Nacional
Autonoma de Mexico

11.1 **Computational Fluid Dynamics and Design of Bioreactors: Role of Hydrodynamic Shear**
J.B. Joshi, S.B.Sawant, A.W. Patwardhan, D.J. Patil and N.K. Nere, University of Mumbai

11.2 **Macro-Segregation of Dissolved Oxygen and Nutrients Inside a Stirred Batch-Fed Plant-Scale Bioreactor**
D. Vlaev and R. Mann, UMIST, V. Lossev, Research Institute for Antibio, S.D. Vlaev, Bulgarian Academy of Sciences, J. Zahradnik, Academy of Sciences of the Czech Republic, P. Seichter, Techmix

11.3 **The Influence of Hydrodynamic Conditions and Composition on the Microstructure of Biopolymer Mixtures in an Agitated Stirred Vessel**
A.W. Pacek and P. Ding, The University of Birmingham

11.4 **A Study of Drop and Bubble Sizes in a Simulated, Mycelial Fermentation Broth of Up to Four Phases**
Enrique Galindo, Universidad Nacional Autonoma de Mexico, Andzej W. Pacek and Alvin W. Nienow, The University of Birmingham

11.5 **Scale-Up of a Two Phase Semi-Batch Exothermic Reaction in a Stirred Tank Reactor**
Carl Knable, Kathleen Barton and Jack Vinson, Monsanto-Searle

11.6 **Parametric Simulations of Non-Newtonian Blending with a Pfaudler Curved-Blade Turbine**
Steven R. Strand, Dow Chemical Co.

11.7 **Effect of Extruder Mixing on MWD and Comonomer Ratio in Co-Polymerizations**
Joseph Grenci and David Todd, New Jersey Institute of Technology

11.8 **Experimental and Simulation Results of Flow in an Intermeshing Co-Rotating Twin Screw Extruder**
S.A. Jaffer, V.L. Bravo, P.E. Wood, A.N. Hrymak, J.D. Wright, McMaster University

11.9 **Selection and Design Criteria for Partially-Filled Multi-Stage Rotating Disc-Blade Processor for Viscous Systems**
W. Roy Penney and Mallick Abdul, University of Arkansas

12:00 Noon *LUNCH/ADJOURNMENT*