Preliminary Program

MIXING XVI

16TH BIENNIAL NORTH AMERICAN MIXING CONFERENCE

JUNE 22-27, 1997
RAMADA INN AND CONFERENCE CENTER HISTORIC AREA
(formerly known as the George Washington Inn)
WILLIAMSBURG, VIRGINIA

Sponsored by

N A M F

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: Ramesh R. Hemrajani, Exxon Research and Engineering Company

Sunday, June 22, 1997

3:00 PM to 9:00 PM	REGISTRATION AND CHECK-IN
9:00 PM to 11:00 PM	RECEPTION

Monday, June 23, 1997

7:00 AM to 8:30 AM	BREAKFAST
8:30 AM to 12 NOON	TECHNICAL SESSION

1. **INDUSTRIAL MIXING PRACTICES**
   Chairs: A. W. Etchells and E. B. Nauman

   Immiscible Liquid-Liquid Mixing: A Technical Review of the Status and Needs
   Douglas E. Leng, Leng Associates, USA

   Analysis and Site Trials of a 64m^3 Glass Lined Mixing Vessel
   Roger King and Steve Cropper, BHR Group Limited, and Jim Buick, Pfaudler-Balfour Limited, UK

   Mixing at 3M: A Company in Transition
   James H. Fox, 3M Abrasives Manufacturing Organization, USA

   Effect of a Parameter of Mixing and Reaction on Additional Reactions Containing Polymerization
   Tetsuo Ezawa and Kuninosuke Nakanisi, Kansai Paint Co.; and Masaharu Takao, Kyushu University, Japan

A Highly Versatile Mixing System for Gas-Liquid and Gas-Liquid-Solid Chemical Reactors
Joshua B. Sweeney, Praxair, Inc., USA

Cleanup of Radioactive Wastes Stored in Tanks Throughout the DOE Complex
L. L. Tavlarides, Syracuse University, USA

Sludge Mobilization and Mixing Techniques for Double Shell Tank Waste at Hanford and Savannah River
Eric A. Daymo, Michael W. Rinker, and Michael R. Powell, Pacific Northwest National Laboratory, USA

12:00 NOON to 1:30 PM LUNCH

5:00 PM to 6:00 PM SOCIAL HOUR

6:00 PM to 7:30 PM DINNER

7:30 PM to 10:00 PM TECHNICAL SESSION

2. **MIXING FUNDAMENTALS**
Chairs: P. E. Wood and R. K. Grenville

Further Studies Using APV-B2 Impellers: Power Characteristics and Mixing Times at Transitional Reynolds Number and With Dual Impellers Under Unaerated and Aerated Conditions
A. W. Nienow, W. Bujalski, D. Hari-Prajitno and V. P. Mishra, University of Birmingham, N. G. Ozcan-Taskan, BHR Group Limited, Z. Jaworski, Technical University of Szczecin, and J. W. McKemmie, APV U.K. Ltd., UK/Poland

Pumping and Mixing of Fluids by Electric Fields
Costas Tsouris, Oak Ridge National Laboratory, USA

Some Fundamentals of Coalescence
E. Bruce Nauman and A. Peter Russo, Rensselaer Polytechnic Institute USA

Fundamentals of Gas-Liquid Mixing in an Industrial Thylosin Reactor
S. D. Vlaev, Institute of Chemical Engineering, R. Mann and D. Vlaev, UMIST, V. Lossev, Research Institute for Antibiotics, J. Zahradnik, Institute of Chemical Process Fundamentals, and P. Seichter, Techmix, Bulgaria

Comparative Study of an Impinging Zone Reactor
Sheng-Yi Lee, Neil Hanney, Peter Ruutel, Peter Barratt, and Y. Pang Tsui, Air Products & Chemicals, Inc., USA

Submersible Paper Pulp Mixers Reduce Power Consumption
Lars Uby, ITT Flygt Products, Sweden

10:00 PM to 11:00 PM SOCIAL HOUR

Tuesday, June 24, 1997

7:00 AM to 8:30 AM BREAKFAST

8:30 AM to 12 NOON TECHNICAL SESSION

3. **MODELLING OF TURBULENT MIXING**
Chairs: E. L. Paul and R. W. Pike

Turbulence Generated by Impellers
Suzanne Kresta, University of Alberta, Canada

A Tool for Quantitative Analysis of Industrial Mixing Processes
Clay Andreasen, Richard LaRoche, and Minye Liu, Silicon Graphics, Inc., USA

Analysis of Turbulent Concentration Fields in Stirred Chemical Reactors Using a RNG Model and Optical Tomography
Tiyun Xu and Ralph W. Pike, Louisiana State University, USA

A Two-Level, Non-Equilibrium Energy Method for Modelling Impeller Flows in Stirred Tanks
Gary K. Patterson, University of Missouri-Rolla, USA

Estimating Blend Times for Stirred Tanks Using Sliding Grid Simulation: A Comparison With Experimental Data
Dan Coy, Nalco Chemical Company, Richard LaRoche, Silicon Graphics/Cray Research, and Suzanne Kresta, University of Alberta, USA/Canada

Validation of CFD Models Using DPIV Data for an Axial Impeller Flow
Jian Sheng, Hui Meng, and Rodney O. Fox, Kansas State University, and Andre Bakker, Chemineer, Inc., USA

Multi-Phase Mixing Using CFX4
H. Hoyal, I. P. Jones, S. M. Lo, and H. Pordal, AEA Technology, USA

12:00 NOON to 1:30 PM — LUNCH

5:00 PM to 6:00 PM — SOCIAL HOUR

6:00 PM to 7:30 PM — DINNER

7:30 PM to 10:00 PM — TECHNICAL SESSION

4. VISCOUS AND NON-NEWTONIAN SYSTEMS
Chairs: T. R. Hanley and V. Atiemo-Obeng

Dynamics, Statistics, and Spatial Structure of the Striation Thickness Distribution Generated by Chaotic Flows
Fernando J. Muzzio and Mario Alvarez, Rutgers University, USA

Prediction of Xanthan Fermentation Development by a Model Linking Kinetics, Power Drawn and Mixing
L. Serrano-Carreon, R. M. Corono, A. Sanchez, and E. Galindo, Universida Nacional Autonoma de Mexico, Mexico

Mixing Analysis of Thixotropic Fluids
D. Rauline, P. A. Tanguy, and P. J. Carreau, Ecole Polytechnique, Canada

A Low-Shear Impeller and Coagulum Reduction in Latex Polymerization
K. Takata, M. Kikuchi, and Y. Okamoto, Shinko Pantec Co., Ltd., Japan

Blending of Miscible, Shear-Thinning Liquids in the Turbulent and Transitional Regimes
Richard Grenville, Dupont Engineering, Steve Ruszkowski, Procter & Gamble Co., and Roger King, FMP, BHRG Ltd., USA/UK

Heat Transfer With Helical Ribbon Type Impellers in Stirred Tanks With High Viscosity Fluids
R. Krebs, P. Forschner, and U. Schmidt, Ekato-Ruhr-und Mischtechnik, Germany

Evolution of Drop Size Distribution in Liquid-Liquid Dispersions for Various Impellers

NAMF STUDENT AWARD WINNER

Genwen Zhou, University of Alberta, Canada

10:00 PM to 11:00 PM — SOCIAL HOUR

Wednesday, June 25, 1997

7:00 AM to 8:30 AM — BREAKFAST

8:30 AM to 12 NOON — TECHNICAL SESSION

5. MICROMIXING AND REACTOR MIXING
Chairs: D. S. Koestler and J. M. Smith

Micromixing: Theory and Experiment
John R. Bourne, Vine House, UK

Scaling-up Agitated Reactor Vessels by Means of Micromixing Models
Harry E. A. Van Den Akker and Remko A. Bakker, Delft University of Technology, Holland

The Effect of Fibres on Local Energy Dissipation in a Medium-Intensity Mixer
J. P. Mmbaga and C. P. J. Bennington, University of British Columbia, Canada

Mixing and Complex Heterogeneous Reactions: It May Take More Than a Paddle
Edward Paul, Karen Larson, Mauricio Futran, Michael Midler, and Michael Thien, Merck & Co., USA

Micromixing Calculations Using CFD: Quantitative and Useful Qualitative Methods
Joe Hannon and Mark Brennan, Performance Fluid Dynamics, Ireland

Correlations for the Prediction of the Minimum Agitation Speed for Complete Suspension of Solids in Stirred Tanks as a Function of Off-Bottom Impeller Clearance
Piero M. Armenante, Ernesto Uehara Nagamine, and Jessica Susanto, New Jersey Institute of Technology, USA

12:00 NOON to 1:30 PM — LUNCH

2:00 PM to 6:00 PM — POSTER SESSION (includes SOCIAL HOUR)

6. POSTER SESSION
Chairs: P. M. Armenante, M. Meili, T. Post, and R. King

1 **A Novel Reactor for Improved Blending Performance**
A. H. John, W. Bujalski, and A. W. Nienow, University of Birmingham, UK

1 **Numerical Analysis of Mixing of a Yield Stress Pseudoplastic Fluid by a Rushton Impeller**
Alexis Espinosa, Arturo Palacio, Alejandro Rodriguez, and Enrique Galindo, National Autonomous University of Mexico, Mexico

1 **Flow and Mixing in an Intermeshing Co-Rotating Twin Screw Extruder**
V. Bravo, S. Jaffer, A. Hrymak, J. Wright, and P. E. Wood, Mcmaster University, Canada

1 **Relating Agitation Number, Bulk Flow and Shear Stress for Fluid Blending Processes**
Hanna Gladki, ITT Flygt Corporation, USA

1 **Non-Invasive Measurement of Stirred Vessel Mixing in 3-D Using Electrical Resistance Tomography**
R. Mann, M. Wang, T. Dyakowski, P. J. Holden, A. E. Forrest, and F. J. Dickin, UMIST, and R. B. Edwards, Port Sunlight Laboratories, UK

1 **Circulation Time Distributions in a Stirred Tank**
Suzanne Kresta, Kristine Dugas, and Gavin McLaren, University of Alberta, Canada

1 **Estimating Blend Times for Stirred Tanks Using Sliding Grid Simulation: A Comparison With Experimental Data**
Richard Grenville, DuPont Engineering, and Richard LaRoche, Silicon Graphics, Inc., USA

1 **Impeller Circulation and Mixing Effectiveness in the Turbulent Flow Regime**
A. W. Nienow, University of Birmingham, UK

1 **Examination of a New Efficient Mixer for non-Newtonian Liquids**

V. Lossev; Antibiotic Co., Bulgaria; St. Krajtchev, Technical University-Sofia, Bulgaria; S. Vlaev, Bulgarian Academy of Sciences, Bulgaria; and R. Mann, University of Manchester, UK

2 **Solids Suspension in Gas-Liquid-Solid Three-Phase Reactors**
Hideki Miura and Yoshinori Kawase, Toyo University, Japan

2 **Solids Suspension**
Kevin D. Maak, Dow Corning Corporation, USA

2 **Solids Suspension With Up-Pumping Impellers**
Kevin J. Myers and Kevin M. Wiwi, University of Dayton, and Andre Bakker and Scott A. Hewitt, Chemineer, Inc., USA

2 **Mixing Performance of a New Make-down Process for High Solids Slurries**
F. Thibault, P. A. Tanguy, and E. Brito-De La Fuente, Ecole Polytechnique, Canada

2 **Matched Refractive Index Techniques for the Study of Multi-Phase Mixing**
J. C. Godfrey, A. C. Johansson, and Z-M. Zhu, University of Bradford, UK

2 **Dry Powder Mixing and Segregation: A Tutorial**
Fernando J. Muzzio and Mario Alvarez, Rutgers University, USA

2 **Mixing and Particle Structure Effects on Flocculation Processes in Stirred Tanks**
Patrick Spicer, University of Cincinnati, USA

2 **A New Jet Mixer for the Re-Suspension of Crude Oil Sludge in Very Large Storage Tanks**
Frikkie L. D. Cloete, University of Stellenbosch, South Africa

3 **Experimental Study of Gas-Liquid Mixing Using a Dual Scaba-Helical Ribbon Impeller System**
T. Espinosa-Solares, E. Brito-De La Fuente, and A. Tecante;National Autonomous University of Mexico, and P. A. Tanguy; Ecole Polytechnique, Mexico/Canada

3 **Dependence of Mixing, Power Consumption and Oxygen Mass Transfer on Impeller Type in Xanthan Fermentations**
A. Amanullah and A. W. Nienow, University of Birmingham, UK

3 **Improved Mixing and Oxygen Delivery in a Novel Continuous Roller Bottle Reactor**
R. Eric Berson,Trupti V. Mane,C. Kurt Svihla,and Thomas R. Hanley,University of Louisville,USA

3 **Operational Characteristics of the Multi-Stage Mechanically-Agitated PROCHEM Column**
A. M. Al Taweel, Technical University of Nova Scotia, and Y. H. Cheng, University of Florida, Canada/USA

3 **Stabilizer Rings and Fins: When to Use These Commonly Specified Impeller Accessories**
James W. Althouse, Pro Quip, Inc., USA

3 **Gas Hold-up in Turbulent Agitated Tanks Containing Shear-Thinning Fluids**
B. C. H. Venneker and H. E. A. Van Den Akker, Delft University of Technology, Holland

3 **Scale-Up of Axial Flow Agitators in Liquid/Solid/Gas Systems**
John A. Von Essen, Philadelphia Mixers Corporation, USA

3 **Use of Helical Screw Impeller in a Draft Tube for Gas Dispersion in a Boiling Reactor**
Howard Altmann, Praxair, Inc., USA

3 **Gas-Liquid Mass Transfer in non-Newtonian Liquids in a Stirred Tank with a Dual Turbine-Helical Ribbon Impeller**

C. Hernandez, University Autonoma de Mexico, Mexico

4 **Numerical and Experimental Evaluation of Static Mixers for Rapidly Reacting Flows**
Paul A. Gillis, Charles W. Lipp, and Robert D. Spradling, Dow Chemical, USA

4 **Model of Polymerization Recycle Reactors With Static Mixers**
Carl Stevens, Steve Strand, and David Eversdyk, Dow Chemical Company, USA

4 **CFD Simulation of Flow Patterns and Turbulence Dissipation Rates in an Opposed Jet Mixing Head**
Fengliang Huang and Thomas R. Hanley, University of Louisville, USA

4 **Simulation of Flow in Helical Ducts Using FLUENT**
Fengliang Huang, Sundeep N. Dronawat, C. Kurt Svihla, and Thomas R. Hanley, University of Louisville, USA

4 **Quantitative Analysis of Laminar Flow Mixing in a Stirred Tank**
Minye Liu, Minnesota Supercomputer Center, Inc., USA

4 **Mixing of Liquids: A System of Calculation Methods and the VisiMix Software**
L. N. Braginsky, Y. V. Kokotov, E. I. Entin, and G. Amir, VisiMix, Ltd., Israel

4 **Gas Holdup Prediction in a Fluidized Bed Biological Reactor Using Modified Drift Flux Theory**
C. J. Fung, N. Ahmed, and G. J. Jameson, University of Newcastle, Australia

4 **STUDENT**

4 **Sliding Mesh Simulation of the Unstable Turbulent Flow Pattern of Axial Pumping Impellers**
Andre Bakker, Chemineer, Inc., and Richard D. LaRoche, Cray Research Park, USA

4 ***STUDENT (NAMF)***

6:00 PM to 7:30 PM DINNER

7:30 PM to 10:00 PM TECHNICAL SESSION

7. **GAS-LIQUID SYSTEMS**
Chairs: G. B. Tatterson and A. Bakker

A Comparative Study of Alternate Gas Dispersion Impellers
Kevin J. Myers and Aaron J. Thomas, University of Dayton, and Andre Bakker and Gregory T. Benz, Chemineer, Inc., USA

Impeller Power Draw and Hydrodynamic Studies in an Agitated, Steam-Sparged, Shallow Dished-Bottom Vessel
C. Kurt Svihla, Wassile Ibrahim, R. Eric Berson, and Thomas R. Hanley, University of Louisville, USA

Single Bubble Mass Transfer in a Boiling Liquid
Christian Ruh and John M. Smith, University of Surrey, UK

Gas Hold-Up With Multiple Impellers
Mike Whitton, Courtaulds Coatings, Ltd., Alvin Nienow, University of Birmingham, and Steve Cropper and Gul Ozcan-Taskin, BHR Group Limited, UK

Behavior of Gas-Liquid Stirred Vessels at High Void Fraction
M. Cooke and J. C. Middleton, ICI Research and Technology Centre, UK

The Use of Computational Fluid Dynamics (CFD) in Mixing Impeller Development
Ronald J. Weetman, Lightnin, USA

10 PM to 11:00 PM SOCIAL HOUR

Thursday, June 26, 1997

7:00 AM to 8:30 AM — BREAKFAST

8:30 AM to 12 NOON — TECHNICAL SESSION

8. **LIQUID-LIQUID SYSTEMS**
Chairs: M. B. Lakin and A. W. Nienow

Dynamics of Drop Breakup in Turbulent Flows
A. M. Al Taweel, Technical University of Nova Scotia, L. D. Walker, Allcell, Ltd., and C. Chen, Falconbridge, Inc., Canada

Drop Breakup in Transient Shear Flow
NAMF STUDENT AWARD WINNER
C. R. Marks, D. I. Bigio, and R. V. Calabrese, University of Maryland, USA

Influence of Impeller Geometry on Liquid-Liquid Mixing With High Volume Fraction Dispersed Phase
A. C. Johansson and J. C. Godfrey, University of Bradford, UK

Coalescence Efficiency in Liquid-Liquid Dispersions in an Agitated Vessel - Modelling and Experimental Verification
A. W. Pacek and A. W. Nienow, The University of Birmingham, UK

High Magnification Video Probe for In-Situ Size Distribution Measurement in Liquid-Liquid and Solid-Liquid Systems
Michael K. Francis, Hartmut Kriegs, and Richard V. Calabrese, University of Maryland, USA

Performance of the Concave-Blade Disc Impeller in Three Phase Mixing
P. R. K. Pantula and N. Ahmed, University of Newcastle, Australia

Acoustic Wave Propagation in Solid-Liquid Suspensions
M. A. Norato, A. S. Sangani, and L. L. Tavlarides, Syracuse University, and M. S. Greenwood, Battelle Pacific Northwest National Laboratory, USA

Maximum Stable and Transient Sizes of Drops in Intermittent Turbulence
Jerzy Baldyga and Wioletta Podgorska, Warsaw Technical University, Poland

12:00 NOON to 1:30 PM — LUNCH

5:00 PM to 6:00 PM — SOCIAL HOUR

6:00 PM to 8:00 PM — NAMF BANQUET AND BUSINESS MEETING

8:00 PM to 10:00 PM — TECHNICAL SESSION

9. **COMPUTATIONAL FLUID DYNAMICS**
Chairs: R. S. Brodkey and M. Chang-Mateu

Scale-Up Procedures for Gas-Liquid Processes, Batch, Continuous, Single & Multi-Stage
James Y. Oldshue, Oldshue Technologies International, USA

Scale-Up of Multi-Impeller Stirred Tank Reactors
Naoki Dohi and Norihiro Itano, Mitsubishi Chemical Corporation, and Kazuhiro Shimizu, Masahito Tao, and Yoshinori Kawase, Toyo University, Japan

Modelling of Flow in Stirred Vessels: Comparison of Snapshot, Multiple Reference Frame and Sliding Mesh Approaches
Vivek V. Ranade, National Chemical Laboratory, Dipankar Choudhury, Fluent, Inc., and Yatin

Tayalia, Flow Consultants, Ltd., India

Effectiveness of CFD in Predicting the Power Drawn by Pitched-Blade and Radial-Disk Turbines in Mixing Tanks
Elizabeth M. Marshall, Ahmad H. Haidari, and S. Subbiah, Fluent, Inc., and Kishore Kar, Dow Chemical Company, USA

Effect of Impeller Type on Solid Suspension in Three-Phase Stirred Vessels
R. Parthasarathy, Royal Melbourne Institute of Technology, and N. Ahmed, University of Newcastle, Australia

Drop Break-up Using a Sawtooth Impeller

FMPSG STUDENT AWARD WINNER

Katrina Beck, BHR Group Ltd., UK

10:00 PM to 11:00 PM — SOCIAL HOUR

Friday, June 27, 1997

7:00 AM to 8:30 AM — BREAKFAST

8:30 AM to 12 NOON — TECHNICAL SESSION

10. HIGH SHEAR MIXING
Chairs: C. P. J. Bennington and P. A. Tanguy

Mixing Phenomena in Agitated Media Mills
A. W. Etchells, Dupont Engineering, USA

High Shear Rotor-Stator Design, an Experimental Approach
Jason J. Zhao, IKA Works, Inc., USA

A Fundamental Analysis of Energy Dissipation in a High Shear Rotor/Stator Mixer
Mark Meili, USA

Laminar Mixing in Kenics Static Mixer
S. Jaffer and P. E. Wood, McMaster University, Canada

Experimental Comparison of Laminar Mixing of Miscible Fluids in Static Mixers and Agitated In-line Mixers
Steve Strand and Carl Stevens, The Dow Chemical Company, USA

Experimental Investigation of Viscosity Ratio Effects on the Performance of Kenics Static Mixers
Mark F. Reeder and Andre Bakker, Chemineer, Inc., and Eric Janz and Kevin J. Myers, University of Dayton, USA

Breakup of Droplets in Hydrodynamic Cavitation Flow
Oleg V. Kozyuk, Five Star Technologies, Ltd., USA

Solids Suspension in Agitated Vessels: Evaluation of Existing Predictive Methods and Development of an Improved Method
W. Roy Penney and Niamul H. Chowdhury, University of Arkansas, and Julian B. Fasano, Chemineer, Inc., USA

12:00 NOON — LUNCH/ADJOURNMENT