

PROGRAM

MIXING XIV

June 20-25, 1993

**Santa Barbara Radisson Hotel
1111 East Cabrillo Boulevard
Santa Barbara, California 93103
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Fax: 805-962-0985**

Co-sponsored by NAMF - North American Mixing Forum

**Chair:
Ronald J. Weetman
Lightnin
716-527-1361**



***Engineering Foundation
345 East 47th Street
New York, NY 10017
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Monday, June 21, 1993

7:30 a.m.

BREAKFAST

9:00 a.m. - 12:00 noon

1.0 MIXER DESIGN AND REAL WORLD PROBLEMS
Chair: Dr. David S. Dickey, Prochem Mixers, Robbins & Myers, Inc.

Chair: Prof. W. Roy Penney, University of Arkansas

1.1 "Mixing and Chemical Reactions in the Production of Specialty Chemicals"

Donald J. Koestler, Rohm and Haas Company

1.2 "Multiphase Reactor Agitation"

Michael B. Lakin, Hoechst Celanese Corp.

1.3 "Design and Scale-up of Compartmented, Staged Processing Equipment with Emphasis on Interstage Mixing"

Julian B. Fasano, Chemineer, Inc., W. Roy Penney * and Bangcheng Xu, University of Arkansas

1.4 "An Experimental Procedure for Scaling-up Shear-Sensitive Agitation Systems with Vastly Different Geometries between Laboratory and Plant Scale"

Douglas Leng, Dow Chemical Company

1.5 "Development of a Hydrogenation Reactor with High Productivity"

P. Forschner (EKATO), R. Krebs (EKATO) and P. Landert (Biazzì)

1.6 "Uprating of a Corrosive, Aggressive, Mass Transfer Controlled Reaction Between a Gas and a Non-Newtonian Slurry"

K.J. Carpenter *, N. Shackley, P.C. Lines and N.B. Dickens, ICI FCMO

1.7 "Flow Stagnation In the Mixing of Pseudoplastic Fluids"

Glenn R. Dalby, E.I. du Pont de Nemours & Company

1.8 "Analysis of the Performance of a Very New 3 Blade Propeller"

Joël Bertrand, Laboratoire de Génie Chimique

12:00 noon

LUNCH

5:00 p.m. - 6:00 p.m.

SOCIAL HOUR

6:00 p.m.

DINNER

7:00 p.m. - 10:00 p.m.

2.0 LIQUID - LIQUID SYSTEMS

Chairman: Prof. Richard V. Calabrese, University of Maryland

Chairman: Dr. John Middleton, ICI

Monday, June 21, 1993 (continued)

- 2.1 **"Droplet Break-up in a Stirred Vessel in the Presence of Emulsifiers"**
Wim Agterof *, Frank Van Dieren and Frans Groeneweg,
Unilever Research Laboratory
- 2.2 **"In Situ Measurements of Local Variations of Volume Fraction with the Ultrasonic Monitor: Applications to Mixing Studies and Phase Inversion for Liquid Dispersions"**
M. Norato, C. Tsouris and L.L. Tavlarides *, Syracuse University
- 2.3 **"Evolution of Drop Size Distributions and Average Drop Diameters in Liquid-Liquid Dispersions Before and After Phase Inversion"**
A.W. Paček, I.P.T. Moore and A.W. Nienow *, University of Birmingham and Richard V. Calabrese, University of Maryland
- 2.4 **"Coalescence of Viscous Drops in a Stirred Dispersion"**
Richard V. Calabrese *, University of Maryland, A.W. Paček and A.W. Nienow, University of Birmingham
- 2.5 **"Modeling the Effect of Drop Charge on Coalescence in Agitated Liquid-Liquid Dispersions"**
T. Tobin* and D. Ramkrishna, Purdue University
- 2.6 **"The Use of Applied Electric Fields to Promote Liquid-Liquid Mixing"**
P.J. Bailes, University of Bradford
- 2.7 **"Minimum Agitation Speed for Complete Liquid Dispersion in Mechanically Agitated Gas-Liquid-Liquid Systems"**
Piero M. Armenante * and Emad Abu-Hakmeb, New Jersey Institute of Technology

10:00 p.m. - 11:00 p.m.

SOCIAL HOUR

Tuesday, June 22, 1993

7:30 a.m.

BREAKFAST

9:00 a.m. - 12:00 noon

3.0 GAS - LIQUID SYSTEMS

Chair: Dr. Edward Paul, Merck & Co., Inc.

Chair: Prof. John Smith, University of Surrey

3.1 "Advanced Measuring Techniques to Characterize Local Mixing and Mass Transfer in Gas-Liquid Reactors"

Andreas Lübbert, University of Hannover

3.2 "Effect of Fluid properties on Scaling-up Gas/Liquid Reactions in Aqueous Polysaccharide Solutions"

Davis W. Hubbard * and Scott E. Ledger, Michigan Technological University

3.3 "Gas-Liquid Mass Transfer Characteristics of Filamentous Suspensions in Tall Tanks"

C. Kurt Svihla * and Thomas R. Hanley, University of Louisville

3.4 "Gas-Liquid Mass Transfer in Industrial Fermenters: Effect of the Uneven Gas Distribution on the Reactor Performance"

S. Sicardi *, L. Manna, F. Chiampo and R. Conti, Torino Polytech

3.5 "Side-Entering Mixer Gas Dispersion"

Kenneth S. Lally *, Thomas A. Post, LIGHTNIN

3.6 "Impeller Power Demand in Boiling Reactors"

John M. Smith * and Athanasios Katsanevakis, University of Surrey

12:00 noon

LUNCH

12:00 noon - 1:30 p.m.

NAMF EXECUTIVE COUNCIL LUNCHEON MEETING

5:00 p.m. - 6:00 p.m.

SOCIAL HOUR

6:00 p.m.

DINNER

7:00 p.m. - 10:00 p.m.

4.0 SOLID - LIQUID SYSTEMS

Chair: Dr. W. Rex Clingan, Syntex Chemicals Inc.

Chair: Prof Davis Hubbard, Michigan Technological University

4.1 "The Use of a Mixing-Sensitive Chemical Reaction for the Study of Pulp Fibre Suspension Mixing"

C.P.J. Bennington * and V.K. Thangavel, University of British Columbia

Tuesday, June 22, 1993 (continued)

- 4.2 **"A Study of Precipitation: Mixing, Size Distribution and Morphology"**
Katsuhiro Inoue and A.W. Nienow *, University of Birmingham
- 4.3 **"Secondary Nucleation by Crystal Collisions"**
Sergio Di Cave and Barbara Mazzarotta *, University of Rome
- 4.4 **"Cloud Height, Fillet Volume, and the Effect of Multiple Impellers in Solids Suspension"**
Michael T. Hicks and Kevin J. Myers *, University of Dayton,
Robert R. Corpstein, André Bakker and Julian Fasano,
Chemineer, Inc.
- 4.5 **"The Influence of Baffle Off-bottom Clearance on the Power Requirement for Complete Suspension of Solids in a Flat Bottomed Tank"**
N. Amed, University of Newcastle
- 4.6 **"Development of Erosion Resistant Mixing Impeller"**
Ronald J. Weetman, LIGHTNIN

10:00 p.m. - 11:00 p.m.

SOCIAL HOUR

10:00 p.m. - 10:30 p.m.

MEETING OF PAST MIXING CONFERENCE
CHAIRPERSONS

Wednesday, June 23, 1993

7:30 a.m.

BREAKFAST

9:00 a.m. - 12:00 noon

5.0 **CHARACTERISTICS OF MIXING FOR SCALE UP**

Chair: Dr. Suzanne Kresta, University of Alberta

Chair: Prof. Bruce Nauman, Rensselaer Polytechnic Institute

5.1 "Imperfect Mixing in a Stirred Semi-batch Reactor: A Product Distribution Paradox on Scaling-up a Triplet Sequence of Reactions"

R. Mann * and A.M. El-Hamouz, UMIST

5.2 "Scale-up Criteria for particle Agglomeration and Migration Effects in Flowing Systems"

Deepak Doraiswamy, DuPont Experiment Station

5.3 "Characterization of the Macromixing State in Vessels Stirred with Multiple Impellers"

F. Magelli * and M. Nocentini, University of Bologna

5.4 "Modelling and Performance Characteristics of Gas-Inducing Impellers"

Stephanie Forrester, University of Cambridge

5.5 "Dimensional Analysis, Similarity and Scale-up for Mixing"

David S. Dickey, Prochem Mixers, Robbins & Meyers, Inc.

5.6 "The Use of Particle Image Velocimetry (PIV) to Study the Instantaneous Velocity Fields on Two Different Scales"

Julian B. Fasano * and André Bakker, Chemineer Inc.

5.7 "Unsteady Aspects of the Flow in Stirred Tanks"

Dallas Chapple and Suzanne Kresta *, University of Alberta

12:00 noon

LUNCH

1:00 p.m.

FIDAP CFD Presentation

1:30 p.m.

FLUENT CFD Presentation

3:00 p.m. - 6:00 p.m.

6.0 **POSTER SESSION** (5 minute presentations first hour. Social hour included) (Papers will remain posted to Thursday at 5:00 p.m.)

Chair: Dr. Ronald J. Weetman, LIGHTNIN

Chair: Mr. Kenneth S. Lally, LIGHTNIN

6.1 "Bubble Size Distribution in an Aerated Stirred Vessel"

A. Ahmed * and R. Parthasarathy, University of Newcastle

- 6.2 **"Analysis of Dilute Liquid-Liquid Dispersions: Mechanisms for Drop Breakup"**
Richard V. Calabrese *, University of Maryland, Bee Yung and Steve Ruszkowski, BHR Group Ltd.
- 6.3 **"Effect of Impeller Clearance and Impeller to Tank Diameter Ratio on Power Draw for Various Radial and Axial Turbines"**
Richard V. Calabrese *, Leslie B. Carroll II, and Jeffrey S. Summers, University of Maryland and Julian B. Fasano, Chemineer, Inc.
- 6.4 **"Particle Suspension and Abrasion - Recent Results"**
A.W. Nienow * and S. Ibrahim, University of Birmingham
- 6.5 **"Power Consumption in Single-Phase Agitated Vessels Provided with Multiple Impellers"**
Piero M. Armenante and Gwo-Ming Chang, New Jersey Institute of Technology
- 6.6 **"Time-Dependent Flow Phenomena in Stirred Vessels"**
H.E.A. van den Akker, Delft University of Technology
- 6.7 **"Pumping Capacity with Aerated Rushton Disk Turbines"**
F. Ait Abderrahim and M. Bruxelmane *, Polytechnique de Mons
- 6.8 **"Process Scale-Up, A,B,C or Z,Y,X"**
James Y. Oldshue, Oldshue Technologies International, Inc.
- 6.9 **"Adaptable Impellers - One Stage Nearer"**
John M. Smith, University of Surrey
- 6.10 **"The Influence of Turbine Type and Position on Batch Transfer from Mixed Tanks"**
Rex Clingan, Syntex Chemicals, Inc.
- 6.11 **"Chemical Selectivity in Turbulent Reacting Flows"**
Mitali Chakrabarti, Fluent Inc.
- 6.12 **"Optimisation of Chlorine Contact Tanks Through Improved Mixing"**
Roger King, BHR Group
- 6.13 **"Liquid Backmixing in Bubble Columns"**
Y.B. Yang, B.S. Zou* and M.P. Dudukovic, Washington University
and M. Chang, Exxon R&D

Thursday, June 24, 1993

7:30 a.m.

BREAKFAST

9:00 a.m. - 12:00 noon

8.0 CFD

Chair: Dr. Kathleen Barton, Dow Chemical

Chair: Prof. Philip Wood, McMaster University

8.1 "3-Dimensional Modeling of Unbaffled Mixing Tanks Using Rotating Coordinates"

S. Strand *, T. Plumley, S. Wood and D. Leng, The Dow Chemical Company

8.2 "A Sliding-Mesh Technique for Simulation of Flow in Mixing Tanks"

Chin-Yuan Peng and Jayathi Y. Murthy*, Fluent Inc.

8.3 "Modeling of a Mixing Tank With a High Recirculation Flow"

Midey Chang-Mateu * and Sudhir Joshi, Rohm and Haas Co.

8.4 "Progress Towards Realistic Turbulence Predictions With CFD"

Joe Hannon, BHR Group

8.5 "Finite Element Flow Simulations in a SMRX Static Mixer"

P. Tanguy *, F. Bertrand and R. Lacroix, Laval University and Rheotek, L. van Dijk, T. Meyer and A. Renken, École Polytechnique Fédérale de Lausanne

8.6 "Numerical Simulation of Buoyant Turbulent Flow Using Low Reynolds Number Turbulence Models"

G. Numberg, P. Wood * and M. Shoukri, McMaster University

8.7 "Numerical Modelling of the Flow In Static Mixers"

André Bakker * and Julian B. Fasano, Chemineer, Inc. and Richard D. LaRoche, Cray Research, Inc.

6:00 p.m. - 8:00 p.m.

NAMF MEETING/AWARDS DINNER

8:00 p.m. - 10:00 p.m.

9.0 PANEL DISCUSSION "INDUSTRIAL MIXING PROBLEMS, SOLVED PROBLEMS OF THE PAST, CURRENT PROBLEMS LOOKING FOR SOLUTIONS, PROBLEMS AND SOLUTIONS YET TO COME"

Chairman: Dr. Arthur Etchells, DuPont Engineering

Panel Members: Julian Fasano, Chemineer, Inc.

Ramesh Hemrajani, Exxon Co.

Roger King, BHR Group

Don Koestler, Rohm and Haas

Doug Leng, Dow Chemical

Mark Meili, Proctor and Gamble

Barry Tamy, Exxon Co.

Wednesday, June 23, 1993 (continued)

- 6.14 "Developing Jet Mixing Specifications for Particulate Laden Suspensions in 3785m³ Double-Shell Tanks"
J.A. Bamberger, Battelle Pacific Northwest Laboratory

6:00 p.m.

DINNER

7:00 p.m. - 10:00 p.m.

7.0 CHEMICAL REACTIONS AND BIOCHEMICAL PROCESSES

Chair: Prof. Kevin Myers, University of Dayton
Chair: Dr. Barry Tarmy, Exxon Research

- 7.1 "Mixing and Fast Competitive Reactions: Effects of Feed Pipe Diameter"
J.R. Bourne, ETH

- 7.2 "Modelling Chemical Reactions at Small Scales in Turbulence"
R.A. Bakker * and H.E.A. van den Akker, Delft University of Technology

- 7.3 "A Probability-Density-Function Study of a Prototypical Turbulent Reactive Flow"
R.O. Fox, Kansas State University

- 7.4 "Recovery of Xanthan from Fermentation Broths by Precipitation in a Stirred Tank"
V. Albiter, L.G. Torres and E. Galindo *, University of Mexico

- 7.5 "Effect of Coalescence Inhibition on Impeller Performance in Gas-Liquid Systems"
T. Martin, C.M. McFarlane * and A.W. Nienow, University of Birmingham

- 7.6 "Agitation Effects on Secondary Metabolite Distribution During Growth of Bac. Subtilis"
J.R. Bourne, ETH

10:00 p.m. - 11:00 p.m.

SOCIAL HOUR

Friday, June 25, 1993

7:30 a.m.

BREAKFAST

9:00 a.m. - 12:00 noon

10.0 VISCOUS MIXING

Chair: Prof. Carl Hoseney, Kansas State University
Chair: Prof. Leon Janssen, Groningen University

0.1 "Elements of Mixing in Extruders"

D.B. Todd, C.G. Gogos, M. Essighir, Polymer Processing
Institute at Stevens Castle Point

10.2 "Axial Mixing in Reactive Extrusion"

H.A. Jongbloed, L.P.B.M. Janssen*, University of Groningen

10.3 "Reactive Compounding, A New Approach"

D. van der Wal *, RUG and L.P.B.M. Janssen, University of
Groningen

10.4 "The Characterisation of the RTD in a Twin-Screw
Extruder"

R.A. de Graaf * and L.P.B.M. Janssen, University of Groningen

10.5 "Macromixing of Rheologically Complex Fluids With Helical
Impellers"

E. Brito de la Fuente, University of Laval and University of
Mexico, P.J. Carreau and J. Cheng, Ecole Polytechnique, and F.
Bertrand, P.A. Tanguy and L. Choplin *, University of Laval

10.6 "A Laser-Doppler Velocimetry Study of Viscous and Non-
Newtonian Fluid Flow in a Stirred Tank Agitated by a 45°
Pitch-Blade Impeller"

Dr. Iain P.T. Moore * and Graham Cossor, University of
Birmingham

10.7 "On the Mixing Requirement of Wheat Flour Dough"

Dr. Kenneth H. Hsu, Nabisco Biscuit Co.

12:00 noon

LUNCH/ADJOURNMENT

* Speaker