



PTF *Newsletter*

Particle Technology Forum

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Vol. 14 No. 2

Spring 2009

The PTF is an international and interdisciplinary forum that promotes information exchange, scholarship, research, and education in the field of particle technology – that branch of science and engineering dealing with the production, handling, modification, and use of a wide variety of particulate materials, both wet or dry, in sizes ranging from nanometers to centimeters. Particle technology spans a range of industries to include chemical, petrochemical, agricultural, food, pharmaceuticals, mineral processing, advanced materials, energy, and the environment. See www.erpt.org/ptf for more information.

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LETTER FROM THE CHAIR

This is my first year as a chair of the forum and I am really looking forward to the opportunity to work with the particle technology community for the next two years. I would like to use the occasion of this newsletter to highlight two important things that I believe make a forum like ours valuable to the particle technology community.

First of all, particle technology is a lively and challenging field. A simple analysis of the work presented at the 2008 Annual Meeting shows our strength. There were a total of 287 contributions including two award lectures, 40 posters and 245 oral presentations. More than 22 countries were represented in the program. At our annual dinner, attended by more than 100 of our colleagues, the PTF recognized four of our members with major awards, and 5 papers and 3 posters presented at the 2007 Annual Meeting for their technical contributions. Our field continues to evolve with a dramatic increase in research in material synthesis, novel characterization methods, computational analyses of particulate systems, and technologies for biomass conversion, novel clean fuels production and capture of greenhouse gases. The particle technology community is contributing significantly to the understanding of how to process difficult materials, such as nanoparticles, and to use sophisticated mathematical modeling to reduce or avoid costly experimentation, as in the design of circulating fluidized beds. The behavior of granular materials is now recognized as a major field in the physical sciences with large research efforts that go beyond the traditional engineering disciplines. These are exciting developments for all of us in the industrial and academic environments.

An unassuming but significant contribution was made by Shrikant Dhodapkar, Ray Cocco, Jennifer Curtis and Barry Tarmy. At the Career Fair in Philadelphia, they presented a particle technology tutorial directed towards undergraduates looking into their technological future. Programs such as these should be a standing part of our effort to inform the engineering community of the impact and contribution of particle technology across the spectrum of technical and societal challenges.

Second, and most important of all, the diverse activities sponsored by the PTF provide an element of personal contact among our members that enriches all of us, both technically and personally. It's our challenge to extend this communication beyond the confines of a few annual meetings. We are hoping that technology, such as the effort spearheaded by Pat Spicer to enrich our web page, will allow us to do that. This is after all a human enterprise.

I cannot complete this letter without some acknowledgements. On behalf of the entire membership, I would like to extend my appreciation to my predecessor, Shrikant Dhodapkar. It will be difficult to match his dedication but, hopefully, with the support of the Executive Committee (Stephen Conway, Jennifer Sinclair Curtis, Joseph McCarthy, Ecevit Bilgili, George Fotou, Hamid Arastapoor, Greg Mehos and Alissa Park), we will at least be able to equal his achievements. I would like to specifically thank in advance two individuals without whom the key functions of the PTF would not be completed. The first is our vice-chair, Ray Cocco, who will succeed me at the end of my term. He will assume the yeoman's responsibility for many of the tasks that make our meetings a success. In addition, Manuk Colakyan, has been the steady, and smart, hand organizing the annual sessions and deserves full recognition for the effort that he has voluntarily committed to the group over numerous years. I am truly happy to have the opportunity to be working with both of them over the coming two years.

Last, but not least, the members of the PTF – it is only through your active participation that the PTF works for all of us.



Hugo Caram
Chair – Particle Technology Forum

2009 AIChE Annual Meeting

November 8-13, 2009

Gaylord Opryland Hotel

Nashville, TN

Abstract Deadline: May 11, 2009

URL: <http://www.aiche.org/Conferences/AnnualMeeting/index.aspx>



PTF Session	Chair	Co-Chair
Agglomeration and Granulation Processes	Paul Mort mort.pr@pg.com	Gabriel I. Tardos Tardos@CCNY.CUNY.Edu
Aggregate and Agglomerate Formation Dynamics	Gregory Beaucage beaucag@uc.edu	Paul Mort mort.pr@pg.com
Applications of Cfd and Population Balance Modeling During Development and Scale-up of Particulate Processes	Pavol Rajniak pavol_rajniak@merck.com	Miroslav Soos miroslav.soos@chem.ethz.ch
Applications of Engineered Structured Particulates	Ranjit Thakur ranjit.thakur@novartis.com	Wai Kiong Ng ng_wai_kiong@ices.a-star.edu.sg
Applications of Fluidization	Manuk Colakyan M.Colakyan@dow.com	Isaac K. Gamwo Isaac.Gamwo@netl.doe.gov
Challenging Problems in Solids Handling – Panel Discussion	Shrikant Dhodapkar sdhodapkar@dow.com	
Characterization and Measurement in Powder Processing	Clive E. Davies C.Davies@massey.ac.nz	Steve J. Tallon s.tallon@irl.cri.nz
Characterization of Engineered Particles and Nano-Structured Particles	Stephen L. Conway Stephen_conway@merck.com	Ah-Hyung Alissa Park ap2622@columbia.edu
Circulating Fluidized Beds	Juray De Wilde dewilde@imap.ucl.ac.be	Allan Issangya allan.issangya@psrichicago.com
Comminution – Experiments, Theory & Modeling	Priscilla Hill phill@che.msstate.edu	R. Bertrum Diemer r-bertrum.diemer@usa.dupont.com
Computational and Numerical Approaches to Particle Flow	Jennifer S. Curtis jcurtis@che.ufl.edu	Chao Zhu chao.zhu@njit.edu
Dynamics and Modeling of Particles, Crystals and Agglomerate Formation	Jan Sefcik jan.sefcik@strath.ac.uk	Roger Place rogerplace@compuserve.com
Dynamics and Modeling of Particulate Systems I	Carl R. Wassgren wassgren@purdue.edu	Vinit S. Murthy vinit@rice.edu
Dynamics and Modeling of Particulate Systems II	Carl R. Wassgren wassgren@purdue.edu	Vinit S. Murthy vinit@rice.edu
Environment and Lifecycle	Charles R. Painter charles.r.painter@navy.mil	Chester Clark chesclark@comcast.net
Fluid-Particle Processing, Liquid-Particle Processing	James F. Gilchrist gilchrist@lehigh.edu	
Fluidization and Fluid-Particle Systems for Gasification and Biomass Utilization	L.-S. Fan fan.l@osu.edu	Atsushi Tsutsumi tsutsumi@chemsys.t.u-tokyo.ac.jp
Fluidization and Handling of Submicron and Nano Particles	Jesse Zhu jzhu@uwo.ca	
Functional Nanoparticles and Nanocoatings on Particles	Lutz Mädler lmaedler@iwt.uni-bremen.de	Alexandra Teleki teleki@ptl.mavt.ethz.ch
Fundamentals of Fluidization – I	T. C. Ho hotc@hal.lamar.edu	Ah-Hyung Alissa Park ap2622@columbia.edu

News and Announcements

Fundamentals of Fluidization – II	Bruce D. Hook BDHook@dow.com	T. C. Ho hotc@hal.lamar.edu
Gas Phase Synthesis of Nanoparticles	Robert N. Grass robert.grass@chem.ethz.ch	Jamie P. Ginn jamie.ginn@usa.dupont.com
Gas/Solid Mixing and Heat/Mass Transfers in Fluidized Beds	Hadjira Iddir Hadjira.Iddir@uop.com	J. Ruud Van Ommen j.r.vanommen@tudelft.nl
Handling of Nanoparticles	Gary Liu Gary.Liu@usa.dupont.com	
Health and Environmental Effect of Nanoparticles	Wendelin J. Stark wendelin.stark@chem.ethz.ch	Lutz Mädler Imaedler@iwt.uni-bremen.de
Industrial Application of Computational and Numerical Approaches to Particle Flow	Ray A. Cocco ray.cocco@psrichicago.com	Reza Mostofi reza.mostofi@uop.com
Liquid-Phase Synthesis of Nanomaterials and Particles	Jan Sefcik jan.sefcik@strath.ac.uk	Christopher L. Kitchens ckitche@clemson.edu
Magnetic Particle Synthesis and Properties	Robert N. Grass robert.grass@chem.ethz.ch	Wendelin J. Stark wendelin.stark@chem.ethz.ch
Material Parameters for Particle Simulations	Joerg Theuerkauf jtheuerkauf@dow.com	Gustavo G. Joseph Gustavo.Joseph@colorado.edu
Mixing and Segregation of Particulates	Ben Glasser bglasser@sol.rutgers.edu	
Modeling and Scaleup of Nanoparticle Processes	M. Silvina Tomassone silvina@soemail.rutgers.edu	Roger Place rogerplace@compuserve.com
Nano-Energetic Materials	Jan A. Puszynski Jan.Puszynski@sdsmt.edu	Bruce Cranford, Jr. Bruce-Cranford-PE@comcast.net
Nanoparticles by Mechanical Breakage and Size Reduction	Karsten Wegner wegner@ptl.mavt.ethz.ch	Gregory Beaucage beaucag@uc.edu
Nanostructured Particles for Catalysis	J. Ruud Van Ommen j.r.vanommen@tnw.tudelft.nl	
Particle and Powder Characterization for Scale-up and Simulations	Shrikant Dhodapkar sdhodapkar@dow.com	Bruce D. Hook BDHook@dow.com
Particle Formation and Crystallization Processes from Liquids, Slurries and Emulsions	Reginald B.H. Tan reginald_tan@ices.a-star.edu.sg	Bing-Shiou Yang bing-shiou.yang@boehringer-ingenlheim.com
Particle Formation in Supercritical Fluids for Food and Pharmaceuticals	Rajesh Dave dave@NJIT.EDU	Ecevit A. Bilgili ecevit_bilgili@merck.com
Particle Technology Forum Poster Session	Manuk Colakyan M.Colakan@dow.com	Hugo S. Caram hsc0@lehigh.edu
Particle Technology Forum Awards Lectures	Hugo S. Caram hsc0@lehigh.edu	Ray A. Cocco ray.cocco@psrichicago.com
Population Balance Modeling for Particle Formation Processes: Nucleation, Aggregation and Breakage Kernels	Roger Place rogerplace@compuserve.com	Edward P. Gatzke gatzke@sc.edu
Post Crystallization Processes	Bruce D. Hook BDHook@dow.com	
Processing and Safety	Dilhan M. Kalyon dkalyon@stevens.edu	Suzanne Prickett suzanne.prickett@navy.mil
Selected Reviews on Fluidization	Jesse Zhu jzhu@uwo.ca	Ray A. Cocco ray.cocco@psrichicago.com
Solids Handling and Processing	Kenneth J. Ford kenneth_ford@merck.com	Clive E. Davies C.Davies@massey.ac.nz
Solids Processing for Polymers	Bruce D. Hook BDHook@dow.com	
Thermophysical Properties	Veera Boddu veera.boddu@usace.army.mil	Paul Redner paul.redner@us.army.mil

Call for PTF Nominations



BEST PH.D. IN PARTICLE TECHNOLOGY AWARD

Winner: 2008 – Janine Galvin

Sponsor: Proctor and Gamble

Description: Recognizes an outstanding dissertation by an individual who has earned a doctoral degree. The dissertation can be in any discipline in the physical, bio-medical or engineering sciences, but must be in particle science and engineering. Selection criteria include: 1. An outstanding original dissertation with relevance to particle technology. 2. The candidate must have received a doctoral degree within the last three calendar years prior to the year the award is given.

Deadline: June 15, 2009. Nominations can be made by any member of the Particle Technology Forum. Nominations should include (1) a letter of nomination, which should include a critical review stating the value of the dissertation in terms of its originality, significance, and potential applications in the field of particle science and technology, (2) an extended abstract of up to six pages including a list of refereed publications resulting directly from that dissertation, (3) a list of refereed publications resulting directly from that dissertation, (4) at least three supporting letters, all of which must be from institutions outside the one granting the dissertation and focus on at least the value of the dissertation in terms of its originality, significance, and potential applications in the field of particle science and technology, and (5) at least one letter from industry. Send nominations to the Particle Technology Forum Awards Committee Chair: Dr. Ray Cocco, Particulate Solid Research, Inc., 4201 West 36th Street, Suite 200, Chicago, IL 60632; Phone: 773-523-7227; Fax: 773-299-1007; E-mail: ray.cocco@psrichicago.com

Award: A plaque and a \$500 honorarium.

Presentation: The award is presented at a PTF-sponsored event during the AIChE Annual Meeting.

Past Recipients: 2007 Mahesh Iyer	2006 Griselda Bonilla
2005 Stephen L. Conway	2004 Ecevit Bilgili
2003 Stephen Tallon	2002 Himanshu Gupta
2000 H. Shinto	1999 R. Agnihotri
1998 Pat Spicer	1997 Christine M. Hrenya

PARTICLE TECHNOLOGY FORUM AWARD

Winner(s): 2008 – L.S. Fan

Sponsor(s): E.I. duPont de Nemours & Company

Description: Recognizes a forum member's significant scientific/technical contributions to the field of particle technology, as well as leadership in promoting scholarship, research, development, or education in this field. Nominee has to be a member of the Particle Technology Forum.

Deadline: June 15, 2009. Nominations for this year's PTF Award can be made by any member of the Particle Technology Forum. Nominations should include: (1) a letter of nomination, which should include a detailed review of contributions made to the field of particle technology with focus on its originality, significance, and potential applications in the field. The letter should also include reference to leadership in promoting scholarship, research, development, or education in PTF field, (2) a list of relevant publications, (3) at least three supporting letters, all of which must be from institutions outside the one granting the dissertation, and (4) at least one letter from industry. Please indicate in the nomination if you would like the nominee to also be considered for the Thomas Baron Award, and the PTF Forum Award. Send nominations to the Particle Technology Forum Awards Committee Chair: Dr. Ray Cocco, Particulate Solid Research, Inc., 4201 West 36th Street, Suite 200, Chicago, IL 60632; Phone: 773-523-7227; Fax: 773-299-1007; E-mail: ray.cocco@psrichicago.com

Award: A plaque and \$1,000 honorarium.

Presentation: The award is presented at a PTF-sponsored event during the AIChE Annual Meeting.

Past Recipients:	2007 L. T. Fan	2006 Doug Fuerstenau
	2005 J. Schwedes	2004 George Klinzing
	2003 Chi Tien	2002 Brian Kaye
	2001 S. K. Friedlander	2000 Brian Scarlett
	1998 Andrew W. Jenike	1997 Reg Davies
	1996 K. Leschonski	1995 Robert Pfeffer

LECTURESHIP AWARD IN FLUIDIZATION

Winner: 2008 – Robert Pfeffer

Sponsor: Particulate Solid Research, Inc.

Description: Recognizes an individual's outstanding scientific/technical research contributions with impact in the field of fluidization and fluid-particle flow systems. Selection criteria include: 1. An outstanding contribution advancing fluidization or fluid-particle flow systems. 2. The awardee is required to deliver a keynote paper at the Fundamentals of Fluidization and Fluid-Particle Systems session of Area 3b during the AIChE Annual Meeting. The awardee is also required to submit a written manuscript. 3. Membership in the Particle Technology Forum or AIChE is not required.

Deadline: June 15, 2009. Nominations for this year's Lectureship Award in Fluidization can be made by any member of the Particle Technology Forum. Nominations should include: (1) A letter of nomination, which should include a detailed review of contributions made to the field of fluidization and fluid-particle systems with focus on originality, significance, and potential applications, (2) a list of relevant publications, (3) at least three supporting letters, all of which must be from institutions outside the one granting the dissertation, and (4) at least one letter from industry. Nominations should be sent to Dr. Ray Cocco, the Particle Technology Forum Awards Committee Chair at Particulate Solid Research, Inc., 4201 West 36th Street, Suite 200, Chicago, IL 60632; Phone: 773-523 7227; Fax: 773-299-1007; E-mail: ray.cocco@psrichicago.com.

Award: A plaque and a \$1,000 honorarium.

Presentation: The award is presented at a Forum sponsored event during the AIChE Annual Meeting.

Past Recipients:	2007 Jennifer Sinclair Curtis	2006 Yong Jin
	2005 Shigekatsu Mori	2004 Ye Mon Chen
	2003 Norman Epstein	2002 Dimitri Gidaspow
	2001 M. Horio	2000 Wen Ching Yang
	1999 Hamid Arastoopour	1998 Joachim Werther
	1997 M. Kwauk	

FLUIDIZED PROCESSING RECOGNITION AWARD

Winner(s): 2007 – Ye Mon Chen

Sponsor(s): Dow Chemical Company

Description: Recognizes a Forum member who has made significant contribution to the science and technology of fluidization or fluidized processes, and who has shown leadership in the engineering community. Awarded bi-annually in odd numbered years.

Deadline: June 15, 2009. Nominations for this year's Fluidized Processing Recognition Award can be made by any member of the Particle Technology Forum. Nominations should include: (1) a letter of nomination, which should include a detail review of contributions made to the field of fluidization and fluidized process. The letter should also include reference to leadership in the engineering community, (2) a list of relevant publications, (3) at least three supporting letters, all of which must be from industry. Two of which should be from outside the company or organization affiliated with the nominee., and (4) at least one letter from academia. Send nominations to the Particle Technology Forum Awards Committee Chair: Dr. Ray Cocco, the Particle Technology Forum Awards Committee Chair at Particulate Solid Research, Inc., 4201 West 36th Street, Suite 200, Chicago, IL 60632; Phone: 773-523 7227; Fax: 773-299-1007; E-mail: ray.cocco@psrichicago.com.

Award: A plaque and \$500.

Presentation: The award is presented at a PTF-sponsored event at the AIChE Annual Meeting.

Past Recipients: 2005 Manuk Colakyan	2003 Hamid Arastoopour
2001 Desmond King	1999 John Chen
1997 Al Weimer	1995 L.S. Fan
1994 Tim Allen	1993 Wen Ching Yang

THOMAS BARON AWARD IN FLUID-PARTICLE SYSTEMS

Winner(s): 2008 – Dilhan Kalyon

Sponsor(s): Shell Global Solutions, Inc.

Description: Recognizes an individual's outstanding scientific/technical accomplishment which has made a significant impact in the field of fluid-particle systems or in a related field with potential for cross-fertilization. Selection criteria include: 1. An outstanding contribution advancing fluid-particle systems, or a related field. 2. The awardee is invited to deliver a Plenary Lecture at an AIChE Annual Meeting session. The awardee is also required to submit a written manuscript.

Deadline: June 15, 2009. Nominations for this years PTF Award can be made by any member of the Particle Technology Forum. Nominations should include: (1) a letter of nomination, which should include a detail review of contributions made to the field of fluid-particle systems or in a field with potential for cross-fertilization, (2) a list of relevant publications, (3) at least three supporting letters, all of which must be from institutions outside the one granting the dissertation, and (4) at least one letter from industry.

Award: A plaque and \$1,000.

Presentation: The award is presented at a PTF-sponsored event during the AIChE Annual Meeting.

Past Recipients: 2007 John R. Grace	2006 Dimitri Gidaspow
2005 Sankaran Sundaresan	2004 Doraiswamy Ramkrishna
2003 Sotiris Pratsinis	2002 Darsh Wasan
2001 L. White	2000 Robert Pfeffer
1998 S.L. Soo	1997 R. C. Flagan
1996 D. D. Joseph	1995 John C. Chen
1994 L. Fan	1993 Roy Jackson

International Conference on Multiphase Flow



International Conference
on Multiphase Flow

www.ICMF2010.eng.ufl.edu

May 30 - June 4, 2010



Marriott Waterside
Hotel & Marina

Tampa, Florida, USA

Host Institution:



Conference Topics

- Bio-Fluid Dynamics
- Boiling
- Bubbly Flows
- Cavitation
- Colloidal and Suspension Dynamics
- Collision, Agglomeration and Breakup
- Computational Techniques for Multiphase Flows
- Droplet Flows
- Environmental and Geophysical Flows
- Experimental Methods for Multiphase Flows
- Fluidized and Circulating Fluidized Beds
- Fluid Structure Interactions
- Granular Media
- Industrial Applications
- Instabilities Interfacial Flows
- Micro and Nano-Scale Multiphase Flows
- Microgravity in Two-Phase Flow
- Multiphase Flows with Heat and Mass Transfer
- Non-Newtonian Multiphase Flows
- Particle-Laden Flows
- Particle, Bubble and Drop Dynamics
- Reactive Multiphase Flows

Abstract Deadline: September 15, 2009

icmf-2010@ufl.edu

WCPT6



The World Congress on Particle Technology (WCPT6) is a scientific congress which is now supported by PARTEC, one of the largest particle technology related events in Europe. WCPT6 will take place simultaneously with POWTECH and TechnoPharm at NürnbergMesse. This fusion of greatest minds in this area of science will provide an amazing exhibition of particle technology for both pharmaceutical and nonpharmaceutical-related fields. This joint venture will present the largest display of process equipment and handling, along with a very unique opportunity for everyone attending to be part of in-depth discussions, scientific presentations for particle processes, its new applications, and know-hows.

WCPT6 will address: aerosols, multi-phase separations, models and simulations, crystallizations, granulations, particle characterizations, comminutions, nano-particles, interphase-controlled systems and processes, as well as bulk solids and applications thereof in the industries of food, pharmaceuticals, electronics, and materials.

Abstracts due July 1, 2009

Conference Website: www.wcpt6.org

AIChE Webinars

The AIChE Webinar Series Requests Your Suggestions

AIChE features one-hour webinars on all topics of interest to chemical engineers. Please suggest a topic or speaker by filling out our Webinar Proposal Form and submitting to the content committee. The form can be found at <http://www.aiche.org/uploadedFiles/Conferences/DepartmentUploads/PDF/3680.final.pdf>. We look forward to your suggestions!



Best Paper Awards from 2008 AIChE Annual Meeting



Sponsored By: Jenike and Johanson, Inc.

2008 Best Paper Awards in Each Division

Group A

Paper 402A

“Use of Co-Milling to Improve Physical Stability of Amorphous Salbutamol Sulphate”

Wai Kiong Ng(1), Vivian S.Y. Wong (2), Prashant N. Balani (2), Sui Yung Chan (2), Reginald B. H. Tan (3)

- (1) Crystallisation and Particle Science, Institute of Chemical and Engineering Sciences, 1 Pesek Road, Singapore, 627833, Singapore,
- (2) Department of Pharmacy, National University of Singapore, 18 Science Drive 4, Singapore, 117543, Singapore,
- (3) Crystallisation and Particle Sciences, Institute of Chemical and Engineering Sciences, 1, Pesek Road, Jurong Island, Singapore 627833, Singapore, Singapore

Group B

Paper 399A

“Syngas Chemical Looping Process”

Fanxing Li, Deepak Sridhar, Hyung Rae Kim, Liang Zeng, Fei Wang, L. -S. Fan
Ohio State University, Ohio, USA

Group C

Paper 445F

“Density Measurements in a Vibro-Fluidized Deep Granular Bed”

Kenneth J Ford, James Gilchrist, and Hugo Caram
Lehigh University, Pennsylvania, USA

Group D

Paper 429A

“Particle Breakage in the Nanometer Range”

Catharina Knieke and Wolfgang Peukert
Institute of Particle Technology, University of Erlangen, 91058 Erlangen, Germany.

Group E

Paper 547C

“Aluminum Burn Rate Modifiers Based on Reactive Nanocomposite Powders”

Demitrios Stamatis, Xianjin Jiang, and Edward L. Dreizin.
New Jersey Institute of Technology, Newark, New Jersey, USA

News and Announcements

2008 Best Poster Awards in Particle Technology

First place

“The Role of Gas-Aerosol Mixing during In-Situ Coating of Flame-Made Titania Particles”
Alexandra Teleki, Martin C. Heine, Frank Krumeich, Kamal M. Akhtar, Sotiris E. Pratsinis

Second place

“Synthesis of Nanoscale Cobalt-Iron Spinel Oxides Via Atomic Layer Deposition and Their Applications for Solar Thermochemical Water Splitting”
Jonathan R. Scheffe, Anthony H. McDaniel, Nathan P. Siegel, Mark D. Allendorf, Alan W. Weimer
University of Colorado at Boulder

Third place

“Modeling of An Industrial Vibrating Double-Deck Screen of a Urea Granulation Circuit”
Ivana Cotabarren, José Rossit, Juliana Piña, Verónica Bucalá
Universidad Nacional del Sur, Camino La Carridanga, Bahia Blanca, Argentinian

Fourth place

“Numerical Simulation of Granular Flow In a Bladed Mixer”
Brenda Remy, Johannes G. Khinast, Benjamin J. Glasser
Rutgers University, New Jersey, USA

Snapshots from 2008 AIChE Annual Meeting





News and Announcements

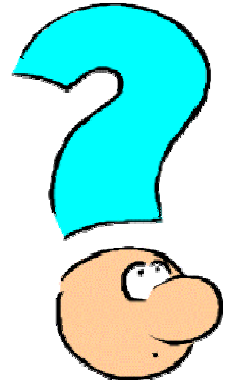




News and Announcements



“Know Floe’s Korner”



Challenges in Handling Fine Powders: Flooding, Flushing and Deaeration

Lyn Bates, Ajax Equipment, UK
Shrikant Dhodapkar, The Dow Chemical Company, TX
George Klinzing, University of Pittsburgh, PA

1. Fine powders with low permeability will exhibit fluid-like behavior due to high degree of aeration and subsequent low de-aeration rates. Uncontrolled and unpredictable discharge of fine powders out of process vessels is called flooding or flushing. Fine powders can flow uncontrollably through belt feeders, vibratory feeders or screw feeders since they rely on cohesion and angle of repose to contain the bulk solid. Fine powders also leak through the clearances of a rotary feeder under a surcharge pressure. These features pose major problems in handling fine powders for industrial applications.
2. Excess gas in the interstitial voids partially supports compacting loads and opposes the development of shear strength, allowing the mass to behave similar to a liquid of very low viscosity. In contrast, the same material in a settled condition exhibits extreme flow difficulties due to its poor permeability which inhibits the expansion of the bulk solids.
3. The flooding tendency of a powder depends both on the bulk material characteristics (particle size, size distribution, permeability, particle density) and on the process conditions (strain rate, discharge rate, residence time, surcharge load or pressure, process temperature, flow pattern). Powders with flooding tendency can, therefore, be handled satisfactorily if proper control of process conditions is maintained.
4. Typical mechanisms for flooding are -
 - a. As the powder from top surface of a rathole (in a funnel flow bin) sloughs off and falls down towards the outlet, it entrains air which causes it to fluidize and flood out of the feeder.
 - b. The residence time of powder in the central core in a bin with *funnel flow* pattern can be very short. If incoming material is not sufficiently de-aerated during its transit time to the feeder, it may flood on reaching the exit.
 - c. If a vessel is filled rapidly with fine powder and discharged without allowing sufficient time to de-aerate, flooding may take place.
 - d. If the relative velocity between particle and air at the silo outlet is higher than minimum fluidization velocity, the powder is likely to fluidize and flood out.
 - e. Uncontrolled air injection in hoppers can result in localized fluidization and create surcharge pressures which aggravate the tendency to flood.
5. Recognize the potential behaviour variation by relating a sample to the Geldart diagram. Bulk materials falling into Class ‘C’ are likely to experience radical differences in flow characteristics according to the state of dilatation and slow to de-aerate when fluidised by agitation or excess air entrainment. Materials with Geldart Class “A” are also prone to flooding if sufficient de-aeration time is not adequate.

6. Note that the viscosity of gases increase with temperature, so that the escape of void gas by percolation is impeded by increased viscous drag at higher temperatures, hence the output from dryers, kilns or other hot regions will exacerbate fluidity problems. These may also be sensitive to ambient variation due to weather or site circumstances.
7. A hopper designed for *mass flow* will not function as such if the internal friction is less than wall friction, the latter not being affected by dilation of the bulk. Even if the stored contents of a hopper are such as to mass flow, the converging section will experience a velocity gradient. The dilated product in the central region will exert a hydrostatic pressure that overcomes the minimum principle stress of the boundary material to progressively penetrate the bed and may eventually flood.
8. There exists a critical strain rate where the material behavior changes from rate-independent transmitted shear stress (powder-like flow) to rate-dependent liquid-like flow. This transition can be sharp or fuzzy but high flow rates increase the flooding risk.
9. Segregation of fines fraction (esp. fraction rich in particle sizes less than 40 μ m) within a silo can create a potential for flooding. Fine fractions lower the critical strain rate required to change bulk material into a liquid like state. Segregation will also cause variations in bulk density, product flowability and product composition (for multi-component mixtures).
10. Measures available to address flooding problems in industrial applications -
 - a. Avoid Funnel Flow pattern in a bin/hopper
 - b. Retain heel of material in bin to avoid immediate discharge from filling.
 - c. Use tangential entry of material as it is fed pneumatically into a bin/silo. Vertical impact can exacerbate fluidization and segregation.
 - d. Design to minimize segregation of fines and coarse
 - e. Allow for sufficient storage/residence time for the material to de-aerate before discharging.
 - f. Minimize surcharge load or gas pressure on top of the bin; ensure good venting.
 - g. Avoid uncontrolled air injection as a flow aid. Provide a continuous, limited-volume rate, air bleed in the region adjacent to the hopper outlet to prevent the void volume and pressure reducing to a value that cannot supply the expansion required for flow to take place. Note that the air injection rate required is very small compared with the rate of loss during settlement of a highly aerated mass. *Interesting Fact:* Jenike[2] used an aquarium pump to inject air into the anthracite hopper to solve the discharge rate problem.
 - h. Consider the use of static de-aeration devices, such as vertical rods or wires, to enhance de-aeration rates. The porosity of packed bed near the wall is slightly higher than in the center. Place a fluidised powder in a deep transparent tube and you will see 'rivulets' of gas run up the walls of a container as gas flow reinforces weak escape channels, rather than work through the close packed bed away from the container surface. Place a thin wire in the centre of the container and a small 'volcano' of gas will erupt at the surface as the 'statistical empty space' forms a deep hole in the bed for air to short circuit the tortuous path through the interstices of a close packed array.
 - i. The above effect can be enhanced by rotating the vertical rods at a natural frequency to generate vertical holes between the nodes in deep beds to short-circuit the gas exit route. Alternately, fit inclined plates that accumulate rising gas from underneath and provide a region shielded from overpressures up which the gas can travel. The contact pressure of the solids under the plates is very low and particles are easily displaced by the increasing gas flow. Inverted 'V' fittings with vent pipes to the headspace to provide a local unconfined surface.

- j. Exploit plane flow and extended outlet slots with progressive extraction to enhance storage capacity for additional residence time and reduce hopper flow velocities and velocity gradients during discharge. An 'extended outlet slot with progressive extraction' is a long hopper outlet (typically served by a screw or belt feeder) which generates "live feed" over the total length. This construction allows a 'V' shaped hopper to be employed that provides plane flow for better discharge than a round or square opening. A 'V' shaped hopper also has more capacity as compared to a conical hopper by virtue of the lower wall inclinations permissible by plane flow. More capacity and larger cross section of flow channel means greater residence time and lower flow velocities that are both favourable for avoiding flooding. It should be noted that the maximum allowable working pressure may be limited for a V shaped hopper design due to flat surfaces.
- k. Consider a large "Inverted Cone Insert" with a relatively narrow annulus, under which is a converging cone where the powder will reliably slide to the final outlet. The flow area of a large, but narrow, annulus can be many times greater than the final outlet because the area increases as the square of the diameter. This will greatly reduce the flow velocity and provide a shallow, unconfined surface under the insert for further de-aeration.

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Upcoming Conference Calendar



2009

International Symposium on Agglomeration 2009

June 22-26, 2009, Sheffield, UK

Abstract deadline: passed

Website: <http://www.shef.ac.uk/agglom2009/>

Particles 2009 - Micro- and Nano-Encapsulation

July 11-14, 2009, Berlin, Germany

Abstract deadline: passed

Website: <http://nanoparticles.org/Particles2009/>

Powders & Grains 2009

July 13-17, 2009, Golden, Colorado

Abstract deadline: passed

Website: <http://PandG2009.mines.edu>

8th World Congress of Chemical Engineering (with Topical Conference on Particle Technology)

August 23-27, 2009, Montreal, Canada

Abstract deadline: passed

Website: <http://www.wcce8.org>

2009 Annual AIChE Meeting

November 8-13, 2009, Nashville, TN

Abstract deadline: May 11, 2009

Website: <http://www.aiche.org/Conferences/AnnualMeeting/index.aspx>

Southern Workshop on Granular Matter 2009

November 30–December 4, 2009, Viña del Mar, Chile

Abstract deadline: October 1, 2009

Website: <http://www.dfi.uchile.cl/~granular09/>



Seventh International Conference on Computational Fluid Dynamics in the Minerals and Process Industries

December 9-11, 2009, Melbourne, Australia

Abstract deadline: passed

Website: <http://www.cfd.com.au/cfdconf/>

2010

Sixth World Congress in Particle Technology

April 26-29, 2010, Nuremberg, Germany

Abstract deadline: July 1, 2009

Website: <http://www.wcpt6.org>

FLUIDIZATION XIII

May 16-19, 2010, Korea

Website: <http://www.engconfintl.org/10af.html>

International Conference on Multiphase Flow

May 30 - June 4, 2010, Tampa, FL

Abstract Deadline: September 15, 2009

Website: <http://conferences.dce.ufl.edu/ICMF2010/>

2010 AIChE Annual Meeting

October 17-22, 2010, Salt Lake City, Utah

2011

2011 AIChE Annual Meeting

October 16-21, 2011, Minneapolis, MN

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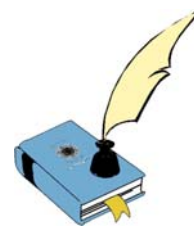
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Technical Programming Area Liaison and Group Chairs

The main focus of the PTF has been arranging for the extensive technical programs at the annual AIChE meeting in November. A lot of hard work goes into developing session themes, negotiating for sufficient time and reasonable scheduling of the sessions, attracting and screening papers, finding and training new session chairs, and making sure the whole process flows smoothly. Shrikant Dhodapkar, our Area 3 Liaison, attends an all-day session each January to plan the technical sessions at the Annual Congress and to arrange for co-sponsored sessions with other Divisions and Forums. Participation in this process is excellent training in and proof of management capabilities. The leaders selected this fall were

<u>Position</u>	<u>Person</u>	<u>Affiliation</u>
Area 3 Liaison	Dr. Manuk Colakyan	The Dow Chemical Co.
Area 3 Vice Liaison	Dr. Shrikant Dhodapkar	The Dow Chemical Co.
<i>Group 3a – Particle Production and Characterization</i>		
Chair	Prof. M. Silvina Tomassone	Rutgers University
Vice-Chair	Dr. Ecevit Bilgili	Merck and Company, Inc.
<i>Group 3b – Fluidization and Fluid-Particle Systems</i>		
Chair	Dr. Jesse Zhu	Univ. of Western Ontario
Vice Chair	Reza Mostofi	UOP LLC
<i>Group 3c – Solids Flow, Handling, and Processing</i>		
Chair	Prof. Benjamin Glasser	Rutgers University
Vice Chair	Dr. Bruce Hook	Dow Chemical
<i>Group 3d - Nanoparticles</i>		
Chair	Professor Yangchuan Xing	University of Missouri-Rolla
Vice Chair	Gary Liu	DuPont
<i>Group 3e – Energetic Materials</i>		
Chair	Charles R. Painter	Department of the Navy
Vice Chair	Jerry S. Salan	Naval Surface Warfare Center

From the Editor's Desk



The *PTF Newsletter* is published twice a year as a vehicle for communication for all PTF members. PTF members are encouraged to send in news and information of general interest to PTF members. Please address your communication to

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1/4 page \$40

1/2 page \$60

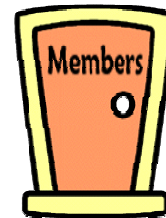
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