PARTICLE TECHNOLOGY FORUM Vol. 18, No. 2, Spring 2013

The PTF Newsletter

CAKING: A UBIQUITOUS PROBLEM IN PROCESS INDUSTRY

KNOW FLOW'S KORNER

Caking refers to the state of powdered product which has lumped or massed by the formation of strong bonds between the constituent particles to an extent that it causes serious operating difficulties. The problem of caking is pervasive in a wide range of industries, such as food, agricultural chemicals, cement, ceramics, sugar, salt, inorganic chemicals, explosives, dyes, pigments, coal, detergents, elastomers, minerals and pharmaceuticals. The cost of product loss, reworking (delumping, grinding) and lost production amounts to billions of dollars.

While there is no dearth of literature or research studies on caking, there appears to be a lack of appreciation amongst the practitioners about the complexity of caking mechanisms and the underlying fundamentals. This is a fertile area for chemical engineers, chemists and chemical physicists who are willing to undertake an inter-disciplinary approach to solve difficult caking problems. One may approach the problem purely as a material science question or as a bulk-solids handling question, or a combination of the two disciplines. At the very least, most of us in particle technology should be aware of the challenges of caking.

Materials with a propensity to cake can be sensitive to a wide range of environmental factors. Temperature and temperature cycles are perhaps the most common. Humidity, moisture and water is also a common factor for promoting caking. Indeed, we are most familiar with this effect as we often see it at home with salt, fertiliser, brown sugar and flour. Pressure and compaction can also caused caking. Finally, a reactive atmosphere has also been known to promote caking. Some materials when exposed to oxygen, carbon dioxide, acids or bases can result in caking.

There are two tactics for addressing caking problems. First and foremost, one must understand the fundamental mechanisms responsible for caking. Several mechanisms cause bulk materials to 'cake' by forming strong bonds between the constituent particles. It is important to identify them and investigate the possibility of modifying the product characteristics or avoid the conditions under which caking develops. Second, post processing solutions are available to handle or modify materials that are prone to caking.

Caking mechanisms can be broadly classified as (i) mechanical, (ii) plastic-flow, (iii) physio chemical, or (iv) electrical. The mechanical classification refers to contact forces that form flats between particles aggravate bonding mechanisms by providing larger surface areas to hold together. It should not be confused with mechanical entanglement of particles similar to "bird's nest" or cotton candy or brush heap that is often observed when particles have high aspect ratio. Although this may have similar detrimental effects on flow and aggravate separate caking mechanisms, no physical binding forces are necessarily present between the contact surfaces. Plastic-flow usually occurs with amorphous or semi-crystalline particles (polymeric, tars, gels, waxes, rubbers) which exhibit plastic or visco-elastic behavior at storage conditions. The bond strength at particle-particle contact is developed due to entanglement and mass transfer at the interface. The physiochemical classification involves materials prone to dissolution or

Table 1: Some Common Examples of Caking in Particulate Systems

Dominate Mechanism	Typical Products	Precautions	Prevention or Mitigation Measures
Crystal growth: Water-soluble materials or chemicals exposed to condensation in humid conditions, or chemicals that dissolve in solvent vapours can form crystal bridges on moistened surfaces between points of particle contact.	Sugars, salts, fertilisers, gravy granules, acids, pigments, detergents, soup and food mixes, plaster, cement, starches, whey powders, egg mixes, flour, milk powder, coffee, flavorings, spices, chocolate powders, powdered drink mixes, cosmetics, seasonings and materials soluble in water or solvents.	Ensure dry material remains dry and is not exposed to humid or vapor laden atmospheres or conditions that promote condensation. Keep moisture content high in moist conditions to prevent the moist particle surfaces from drying. Use dry air for pneumatic conveying, employ mass flow hoppers, avoid static storage and residue areas, promote bulk deformation, if practical; e.g. by cross inserts in parallel bodies of hoppers.	Use anti-caking agents, such as stearates, talc, dicalcium phosphate, calcium silicate, fumed silica, sodium aluminosilicate, potato starch, kaplin or store in dried or inert atmosphere and avoid temperature changes or enlarge particle size and/or change shape to reduce bonding areas and contact frequency.
Oxidation: It is sensitive to small moisture changes and increases with temperature and time.	Materials that are ferrous based or contain copper, aluminum, magnesium, carbon or coal.	Prevent condensation and moist atmospheres. Avoid extended storage and exposure to moisture, heat and temperature variations.	Use inert local atmosphere with nitrogen, carbon dioxide or argon for long-term storage. Packaging with barrier layers.
Hydration: Minerals hydrate by converting an oxide to a double hydroxide or incorporation of water molecules directly into the crystalline structure of a new mineral, as in the hydration of feldspars to clay minerals, garnet to chlorite or kyanite to muscovite.	Portland cement, phosphates	Keep dry and protect from moisture ingress, condensation and temperature variations	Packaging with barrier layers. Use an inert local atmosphere with nitrogen, carbon dioxide or argon for long-term storage.

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Table 1 (Continued): Some Common Examples of Caking in Particulate Systems

Dominate Mechanism	Typical Products	Precautions	Prevention or Mitigation Measures
Drying : Dried bulk products are rarely completely devoid of moisture because, even if the particles are dry, the air in the voids tends to have high humidity. As the material cools, moisture is expelled from the combined gas of air and water vapour to condense on the nearest colder surface. Drying damp products can also activate thermal softening of the particles to deform and present surfaces in close proximity to bond or sinter. The presence of oils or salts can develop sticky contacts or lead to crystal growth	Materials with water-soluble components, or solids with fine components such as clay in limestone, coal or ores.	Avoid drying by spraying the surface with water. Do not purge the vessel with dry air.	
Elastic deformation: Plastic or elastic changes allow contact points to become flattened. This attains a much more stable structure and molecular and electrostatic forces become significant between the close surface proximities. Springy solids can develop serious cohesion or interlocking problems. Heat or moisture can relax the deformation but once the conditions are removed, the problems redevelops and can be severe.	Materials in the form of flakes, stringy lengths or thin chips of polymers, elastomers, wood chips, fiberglass, noodle-like extrudates.	Maintain cool and dry condition. Avoid stress.	Minimize solids contact pressure with inserts and design to promote mass flow, eliminate temperature fluctuations and avoid impact loading of susceptible materials. Allow expansion at extraction point.
Oil deposits: High temperatures can draw out the natural oils in particles. A decrease in temperature afterward can allow the material to dry and cause the particles to stick together.	Materials containing natural oils such as soybean meal, or products with oil content, such as cakes mixes.	Reduce storage temperatures, promote interparticle motion during storage and design vessels to promote flow at the walls to prevent hang-ups.	

Continued on Next Page

sublimation followed by recrystallizaton, dehydration or rehydration, oxidation or phase transition such as solid to solid or solid to liquid (two or multiple components). The electrical classification includes material caking due to piezoelectrical, pyroelectrical, ferroelectrical or coulombic effects.

ADDRESSING CAKING ISSUES

There is no guaranteed way to predict exactly how any one bulk solid will behave based on associated experience alone. Even research and development, process calculations and pilot plant studies may not prevent material handling problems in production systems subject to variability in product, production and environment. The only effective way to predict and avoid processing problems is by measuring the material's flow properties at simulated plant conditions and using this data to design or recommend equipment. This means duplicating temperature, storage time, chemical reactions and solids contact pressures, while taking into consideration the construction materials used in the process or storage vessel. If you do have a caking use popping up, there are ways to mitigate it.

The basic methods that counter caking are to (i) disrupt the mechanism responsible for caking by altering product characteristics either by changing the chemistry or particle morphology (i.e., change particle size or morphology), (ii) avoid the conditions that allow caking mechanisms to develop (i.e., temperature or moisture control), (iii) mechanically disturb the caked structure, and/or (iv) add anti-caking additives to prevent caking from taking place. As caking is a time-dependent process, it may be possible to manage the situation by strict operational control of storage times.

Some common examples of these mitigation measures are summarized in Table 1.

PREVENTING CAKING

In industry, the most common method for mitigating caking is with the addition of one or more additives. Additives prevent caking by coating the host particles with smaller, inert ones that prevent intimate contact from taking place between the particles prone to develop firm connections or absorb moisture that would lead to caking processes. Whereas the primary functions of these anti-caking agents are to separate susceptible particles, to either absorb moisture, or prevent it from contacting the particle surfaces. Anti-caking additives have additional advantages, namely

Improve flow and increase packaging rates,

- Aid the consistency of bulk density,
- Reduce or prevent build up in spray drying operations,
- Reduce adhesion to contact surfaces,
- Decrease dusting,
- Prevent the formation of lumps,
- Absorb liquids, fats, and oils for powdered food applications,

- Decrease clogging and bridging during production, and
- May also be added to improve taste, texture, reduce mold, improve color or appearance.

Some anti-caking organic solvents are soluble in water. Others are soluble in alcohol or function by adsorbing excess moisture or by coating particles and making them water repellent. Calcium silicate ($CaSiO_3$), a commonly used anti-caking agent, added to (i.e., table salt, absorbs both water and oil). Anti-caking agents are also used in non-food items such as road salt, fertilisers, cosmetics synthetic detergents, and in manufacturing applications.

Table 2 shows some of the more common materials used to prevent caking in the industry.

Table 1 (Continued): Some Common Examples of Caking in Particulate Systems

Dominate Mechanism	Typical Products	Precautions	Prevention or Mitigation Measures
Release of chemically bound water: Some materials will hydrate with moisture from the atmosphere. If chemically bound water settles on the outside surface of the particles and the temperature drops, the water can combine with the material and form a strong bond between particles	Gypsum, limestone, Kernite and materials that have hydration temperatures close to room temperature.		Keep the material dry, convey in dry air and do not place hot material in cold storage vessels. Purge storage vessels with dry air or nitrogen and avoid temperature cycles that transverse hydration temperatures.

USEFUL REFERENCES

1. Griffth, E.J., Cake Formation In Particulate Systems, VCH Publishers, 1991
2. Wahl, M, Brockel, U, Brendel, L, Feise, H.J., Weigl, B., Rock, M., Schwedes, J. Understanding powder caking: Predicting cake strength from individual particle contacts, Power Technology, 188 (2008) 147-152.
3. Hartmann, M, Palzer, S., Caking of amorphous powders – Material aspects, modelling and applications, Powder Technology, 206 (2011) 112-121.
4. Rock, M., Schwedes, J., Investigation of caking behavior of bulk solids – macroscale experiments, Powder Technology, 157 (2005) 121-127.

by Lyn Bates (Ajax Equipment, UK), Shrikant Dhodapkar (Dow, USA), George Klinzing (University of Pittsburgh, USA)

Table 2: Some Common Materials Used to Prevent Caking

Tricalcium Phosphate	Magnesium stearate	Sodium silicate
Powdered cellulose	Sodium ferrocyanide	Potassium ferrocyanide
Calcium ferrocyanide	Sodium bicarbonate	Silicon dioxide
Calcium silicate	Bone phosphate	Talcum powder
Sodium aluminosilicate	Magnesium trisilicate	Aluminum silicate
Calcium aluminosilicate	Bentonite	Powdered Rice
Stearic acid	Polydimethylsiloxane	

Interested in helping the PTF as a sponsor? We have opportunities for sponsoring awards and dinners. Sponsorship brings recognition in our newsletter and website. Please contact Ray Cocco at ray.cocco@psrichicago.com

JENIKE & JOHANSON Bulk Solids: Science/Engineering/Design

Sponsor of the 2012 PTF Reception

Sponsor of the 2012 PTF Dinner

cpfd COMPUTATIONAL PARTICLE FLUID DYNAMICS

The Call for Papers is NOW open for AIChE's 2013 Annual Meeting in San Francisco, CA to be held at the Hilton San Francisco Union Square, over the dates of November 3-8, 2013. The Call For Papers can be accessed here: https://aiche.confex.com/aiche/2013/cfp.cgi

The deadline for submissions is Monday, May 13th, 11:59pm EDT.

All past PTF newsletters are now archived at the PTF site on the Newsletter section under the menu heading "Activities". The direct link to the Newsletter section is http://aicheptf.org/activities/newsletter. **As always, please email any comments, suggestions, or concerns regarding the web site to Pat Spicer at** spicer.pt@pg.com

HELP MAKING IT ALL WORK

LETTER FROM THE CHAIR

Thanks to the efforts and hard work by our previous Particle Technology Forum (PTF) Chair, Dr. Ray Cocco (President, Particulate Solid Research, Inc.), PTF is alive and well. The PTF technical sessions at the Annual AIChE Meeting in Pittsburgh were packed – actually overflowing - with attendees. We also had a terrific turnout for our PTF banquet! I look forward to serving these next two years as PTF Chair and further energizing this great professional organization.

If you want to reap the full benefits of PTF membership and engage with PTF, you can do so by participating in a number of ways:

- Mark your calendar now and plan to attend and participate in the PTF technical sessions at the upcoming 2013 Annual AIChE Meeting in San Francisco. San Francisco is consistently the annual meeting site with the highest attendance, so you will be sure to interact with most everyone there. The dates are November 3-8, 2013. All the technical sessions will be one location – the Hilton Hotel – so if you don't like walking between buildings to hear various talks, it won't be happening at this meeting. And, make sure to sign up for the PTF banquet when you register for the meeting.
- Volunteer to chair or co-chair a technical session at the annual meeting. Please contact Manuk Colakyan (manukc@aol.com) if you would like to serve in this capacity.
- Volunteer to be a judge at our annual poster competition during the annual meeting. Three posters are chosen each year for recognition. Please let Reza Mostofi (reza.mostofi@uop.com) if you would like to participate.
- Volunteer to engage with undergraduate students on the Saturday (November 2) before the AIChE Meeting. Each year PTF gives an overview of the particle technology field with interesting demos to garner more interest in our field among the future engineering workforce. Please contact Ray Cocco (raycocco@mac.com) if you would like to interact with these chemical engineering students.
- Honor one of your deserving colleagues by nominating them for one of our PTF Awards. Award information and deadlines are in this newsletter.
- Check out our PTF website http://aicheptf.org/ for more information on PTF and PTF-related activities.
- Provide our webmaster, Patrick Spicer (p.spicer@unsw.edu.au) or our newsletter editor, Christine Hrenya (hrenya@colorado.edu) with material or other information that you think would be useful to disseminate to other PTF members via these communication outlets.

Finally, if you would really like to get involved with the inner workings of PTF, please let me (jcurtis@che.ufl.edu) know if you would like to be considered for election to the Executive Committee.

All the best for a productive and successful 2013!

Jennifer Sinclair Curtis, PTF Chair

SAVE THE DATE
2013 AIChE Annual Meeting
November 3-8, 2013
Hilton San Francisco
Union Square
San Francisco, CA

University of Pittsburgh

University of Pittsburgh Alumni
Sponsor of the 2012 George Klinzing Best PhD Award

DUPONT The miracles of science

DuPont
Sponsor of the 2012 PTF Award

DOW

Dow
Sponsor of the 2012 Fluidization Processing Award

Shell Global Solutions
Sponsor of the 2012 Thomas Baron Award

PSRI Particulate Solid Research, Inc.

PSRI
Sponsor of the 2012 Lectureship in Fluidization Award

2012 PTF AWARD RECIPIENTS

George Klinzing Best PhD Award (Sponsored by Pittsburgh Alumni)
Dr. Mayank Kashyap
Process Technology Fluidization Engineer
Ascend Performance Materials, LLC

Particulate Solid Research, Inc. Lectureship Award
Prof. Xiaotao (Tony) Bi
Professor and Director of UBC Clean Energy Research Centre
The University of British Columbia

Shell Global Solutions Thomas Baron Award
Prof. James D. Litster
Professor of Chemical Engineering & Professor of Industrial & Physical Pharmacy
Purdue University

The miracles of science

DuPont PTF Award for Lifetime Achievements
Prof. John R. Grace
Professor and Canada Research Chair
The University of British Columbia

PTF Service Award
Ralph Nelson

2013 PTF AWARD NOMINATION

DUE MARCH 17, 2013

Now is the time to nominate this year's recipients and now with our similar nomination form. Provide your candidate name, proposed award and a 25 word or less citation to http://www.aicheptf.org or http://form.jotform.us/form/30437987792167 or reza.mostofi@honeywell.com

Award	Sponsor	Description
George Klinzing Best PhD Award	Pittsburgh Alumni University of Pittsburgh	Best dissertation in particle technology
Thomas Baron Award	Shell Global Solutions	Best recent work in particle technology
PTF Award	TBA	Lifetime achievement in particle technology
Lectureship Award in Fluidization and Fluid Particle Systems	Particulate Solid Research, Inc.	Achievement in fluidization and fluid particle systems
Fluidized Processing Award	Dow Chemical	Outstanding contributions to commercialized processes

In an effort to simplify the nomination process for various PTF awards, this year an initial screening step is added to the selection practice. If selected, your completed nomination form is due by **April 30, 2013.**

National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

EMPLOYMENT OPPORTUNITY FOR PARTICULATE AND MULTIPHASE PROCESSES PROGRAM DIRECTOR IN THE DIVISION OF CHEMICAL, BIOENGINEERING, ENVIRONMENTAL, AND TRANSPORT SYSTEMS (CBET), DIRECTOR OF ENGINEERING (ENG)

The Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), within the Directorate for Engineering at the National Science Foundation (NSF), announces a nationwide search for an engineering professional to fill the following position:

Program Director: Particulate and Multiphase Processes Program

Formal consideration of interested applicants will begin November 19, 2012, with an approximate beginning appointment date of August 2013.

While disciplinary expertise will be expected for the program director, the focus of the search is to locate a scholarly, open-minded, diverse and intellectually integrated individual to join the present team in sharing The Engineering Directorate's responsibilities within NSF's overall mission: to promote the progress of science and engineering; to advance the national health, prosperity, and welfare; and to secure the national defense.

BRIEF PROGRAM DESCRIPTION

The Particulate and Multiphase Processes program supports fundamental and applied research on mechanisms and phenomena governing particulate and multiphase processes, including granular and granular-fluid flows, particle/bubble/droplet interactions, aerosol science and technology, suspensions,micro- and nano-structured fluids, self- and directed-assembly of nanostructures involving particulates, and related instrumentation and diagnostics. Innovative research is sought that contributes to improving the basic understanding, design, predictability, efficiency, and control of particulate and multiphase processes with particular emphasis on: new frontiers in nanotechnology, novel manufacturing techniques, nano-metrology, bioengineering systems, environmental sustainability, critical infrastructure systems, and complex engineering systems. Current funded research areas include multiphase flow phenomena, particle science and technology, multi-scale models of multicomponent systems, and transport of multiphase systems in biological systems.

NSF Program Directors bear the primary responsibility for carrying out the Agency's overall mission. To discharge this responsibility requires not only knowledge in the appropriate disciplines, but also a commitment to high standards, a considerable breadth of interest and receptivity to new ideas, a strong sense of fairness, good judgment, and a high degree of personal integrity.

Qualification requirements include a Ph.D. or equivalent professional experience in the relevant discipline, plus six or more years of successful research, research administration and/or substantial managerial experience in academe, industry, or government. Appointees are expected to have significant and relevant knowledge of research related to the program. Also desirable is knowledge of the general scientific community, skill in written communication and preparation of technical reports, an ability to communicate orally, and several years of successful independent research of the kind normally expected of the academic rank of associate or full professor. Research accomplishments on topics related to the program are highly desirable. All appointees are expected to function effectively both within specific programs and in a team mode, contributing to and coordinating with organizations in the Directorate, across the Foundation, and with other Federal and State government agencies and private-sector organizations as necessary. Such responsibilities can include serving on committees developing new administrative approaches and implementing new focused research activities.

Periodic appointments to leadership of inter-divisional, inter-directorate and interagency programs may be made. NSF is an equal opportunity employer committed to employing a highly qualified staff that reflects the diversity of our nation.

Program Director positions recruited under this announcement may be filled by one of the following appointment options:

Intergovernmental Personnel Assignment (IPA) Act: Individuals eligible for an IPA assignment with a Federal agency include employees of State and local government agencies or institutions of higher education, Indian tribal governments, and other eligible organizations in instances where such assignments would be of mutual benefit to the organizations involved. Initial assignments under IPA provisions may be made for a period up to two years, with a possible extension for up to an additional two-year period. The individual remains an employee of the home institution and NSF provides the negotiated funding toward the assignee's salary and benefits. Initial IPA assignments are made for a one-year period and may be extended by mutual agreement.

Visiting Scientist Appointment: Appointment to this position will be made under the Excepted Authorityof the NSF Act. Visiting Scientists are on non-paid leave status from their home institution and placed on the NSF payroll. NSF withholds Social Security taxes and pays the home institution's contributions to maintain retirement and fringe benefits (i.e., health benefits and life insurance), either directly to the home institution or to the carrier. Appointments are usually made for a one-year period and may be extended for an additional year by mutual agreement.

Temporary Excepted Service Appointment: Appointment to this position will be made under the Excepted Authority of the NSF Act. Candidates who do not have civil service or reinstatement eligibility will not obtain civil service status if selected. Candidates currently in the competitive service will be required to waive competitive civil service rights if selected. Usual civil service benefits (retirement, health benefits, and life insurance) are applicable for appointments of more than one year. Temporary appointments may not exceed three years.

For additional information on NSF's rotational programs, please visit:

http://nsf.gov/about/career_opps/rotators/.

Applications will be accepted from US Citizens. Due to a recent change in Federal Appropriations Law, only Non-Citizens who are permanent US residents and actively seeking citizenship can be considered for Federal appointments (i.e., Visiting Scientists, Engineers and Educators (VSEE) program, Temporary Excepted Service). Therefore, you are required to provide documentation that confirms you are actively seeking citizenship at the time you submit your application. Non-citizens who do not provide documentation will be considered only for the IPA program.

Should you or your colleagues be interested in this position, or wish to nominate suitable candidates, please email a current CV accompanied by a cover letter that highlights the background that specifically relates to the program objectives to:

Dr. Robert Wellek, Search Committee Coordinator,
Deputy Division Director,
Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET)
National Science Foundation
4201 Wilson Boulevard, Room 565
Arlington, Virginia 22230
Phone: (703) 292-8320 | Fax: (703) 292-9054 | e-mail: rwellek@nsf.gov

NSF IS AN EQUAL OPPORTUNITY EMPLOYER COMMITTED TO EMPLOYING A HIGHLY QUALIFIED STAFF THAT REFLECTS THE DIVERSITY OF OUR NATION

Conference Calendar

PARTEC 2013
International Congress on Particle Technology
April 23-25, 2013, Nuremberg, Germany
http://www.partec.info/

Fluidization XIV
May 25 - 30, 2013, Noordwijkerhout, The Netherlands
http://www.engconfintl.org/13afabout.html

International Conference on Multiphase Flow 2013
May 26 - 31, 2013, Jeju, Korea
http://www.icmf2013.org/

2nd IMA Conference on Dense Granular Flows
June 1 - 4, 2013, Cambridge, UK
http://www.ima.org.uk/conferences/conferences_calendar/dense_granular_flows.cfm

2013 Process Development Symposium
June 11-13, 2013
Oak Brook, IL (Chicagoland)
http://www.aiche.org/conferences/process-development-symposium/2013

6th International Granulation Workshop
June 26-28, 2013, Sheffield, UK
http://www.shef.ac.uk/agglom/2013

6th International Conference on Discrete Element Methods
August 5-6, 2013, Golden, CO
http://csmspace.com/events/dem6/papers.html

Abstract due March 1, 2013

Gas-Liquid-Solid 11 (GLS-11)
A Special Symposium for th 9th World Congress of Chemical Engineering
August 19 - 22, 2013, Coex, Seoul, Korea
http://www.wcce9.org/program/program04.asp?sMenu=pro3

Powders & Grains 2013
August 19 - 22, 2013, Sydney, Australia
http://www.pg2013.unsw.edu.au/

5th International Conference on Population Balance Modelling
September 11-13, 2013
Bangalore, India
http://pbm2013.serc.iisc.ernet.in

2013 AIChE Annual Meeting
November 17 - 22, 2013, San Francisco, CA
http://www.aiche.org/conferences/aiche-annual-meeting/2013

Abstract due May 13, 2013

The 7th World Congress on Particle Technology
May 19-22, 2014, Beijing, China
http://www.wcpt7.org

Abstract due Oct 31, 2013

Gordon Research Council on Granular & Granular Fluid Flow
July 20-25, 2014
Stonehill College, Easton, MA
http://www.grc.org/programs.aspx?year=2014&program=granular

Application due Jun 22, 2013

PTF Treasury Report

Prepared by Prof. Ah-Hyung Alissa Park

Item	Ref Date	AIChE PTF Account		Independent PTF Account	
		Activity	Balance	Activity	Balance
Starting Balance	Apr-12		$10,583.92		$ 5,657.97
Dues Income	May-12	$ 90.00	$10,673.92		$ 5,657.97
Dues Income	Jun-12	$ 15.00	$10,688.92		$ 5,657.97
Totals			$ 10,688.92		$ 5,657.97

Note: Cash due from AIChE (7/2012) is $3,025.00

Group 3A: Particle Production and Characterization

Dr. Pavol Rajnaiak (Chair) & Prof. Rajesh Dave (Co-chair)

Session ID	Session Title	Chairs	Co-Chair(s)	Co-Sponsor
03A00	Particle Engineering as Applied to Pharmaceutical Formulations	E. Bilgili	I. Akseli	
03A01	Engineered Composite Particulate Systems for Pharmaceutical Active Ingredient Delivery	S. Conway	R. Dave; I. Akseli	
03D01	Gas-Phase Synthesis of Nanoparticles	K. Wegner	B. Schimmoeller	Group 3D
02B01	Particle Formation and Crystallization Processes From Liquids, Slurries, and Emulsions	N. Nere,	S. Ramakrishnan	Group 2B
03A02	Agglomeration and Granulation Processes	D. Talay	P. Narayan, M. Kheiripour	
03A03	Population Balance Modeling for Particle Formation Processes: Nucleation, Aggregation and Breakage Kernels	P. Rajniak	R. Ramachandran	
03A04	Applications of Engineered Structured Particulates	P. Bell	W-K. Ng	
03C04	Characterization and Measurement in Powder Processing	M. Kheiripour	C. Davies	Group 3C
03A05	Characterization of Engineered Particles and Nanostructured Particulate Systems	D. Lepek	S. Conway	
03A06	Dynamics and Modeling of Particles, Crystals and Agglomerate Formation	R.D. Vigil	D. Shi	
23A06	Nanomaterials and Nanotechnology Sustainability	B. Karn	Y. Huang	Group 23A
03A07	Particle Breakage and Comminution Processes	P. HIll	E. Bilgili	
03A08	Magnetic Particle Synthesis and Properties	F. Stepanek	R. Rajniak	

Group 3B: Fluidization and Fluid-Particle Systems

Prof. Ah-Hyung Park (Chair) & Dr. S.B. Reddy Karri (Co-chair)

Session ID	Session Title	Chairs	Co-Chair	Co-Sponsor
03B01	Special Session: to Celebrate Prof. Derek Geldart's Career Long Accomplishments	R. Cocco	T. Knowlton	
03B02	Fundamentals of Fluidization I	S.B.R. Karri	R. Lau	
03B03	Fundamentals of Fluidization II	R. Mostofi	J. McMillan	
03B04	Fundamentals of Fluidization III	F. LI	M. Sunborn	
03B05	Fluidization and Fluid-Particle Systems for Energy and Environmental Applications	R. Breault	A. Ahmadzadeh	
03B06	Industrial Application of Computational and Numerical Approaches to Particle Flow	T. Healy	S. Ozarkar	
03B07	Circulating Fluidized Beds and Measurement Techniques in Fluid-Particle Systems	A. Issangya	T. Li	
03B00	Special Session: to Celebrate Prof. Howard Littman's Career Long Accomplishments	G. Belfort	L-S. Fan, A. Park	

Group 3C: Solids Flow Handling and Processing

Prof. Kimberly Henthorn (Chair) & Dr. Ben Freireich (Co-chair)

Session ID	Session Title	Chairs	Co-Chair	Co-Sponsor
03C01	03C01 Mixing and Segregation of Particulates	W. Shi	R. Ramachandran	
03C02	Dynamics and Modeling of Particulate Systems I	M.S. Tomassone	B. Freireich	
03C03	Dynamics and Modeling of Particulate Systems II	W. Ketterhagen	C. Wassgren	
03C04	Characterization and Measurement in Powder Processing	M. Kheiripour	C. Davies	Group 3A
03C05	Drying of Particulates: Applications and Fundamentals	K. Henthorn	K. Jacob	
03C06	Gas-Solid Transport and Separations	S. Dhodapkar	G. Klinzing	
03C07	Panel Discussion: Challenges in Validation of Computational Codes (DEM)	S. Dhodapkar	J. McCarthy	
03C08	Aeration Effects on Hopper Flows	K. Johanson	K. Jacob	
03C09	Biomass Characterization, Handling, and Processing for Bioindustries	M. Colakyan	G. Liu	
12A00	Crystallization Process Development	J. Marek	C. Wibowo, B. Hook	Group 12A
03D00	Processing and Handling of Nano- and Nanostructured Particles	B. Schimmoeller	K. Wegner	Group 3D
03C00	Solids Handling and Processingq	M. Kheiripour	K. Henthorn	

Group 3 Special Sessions

Session ID	Session Title	Chairs	Co-Chair	Co-Sponsor
03000	Particle Technology Forum Awards Lecture	R. Cocco	M. Colakyan	
03001	Particle Technology Forum Poster Session	M. Colakyan	R. Cocco	

Group 3D: Nanoparticles

Dr. Karsten Wegner (Chair) & Dr. Bjoern Schimmoeller (Co-chair)

Session ID	Session Title	Chairs	Co-Chair	Co-Sponsor
03D01	Gas Phase Synthesis of Nanoparticles	K. Wegner	B. Schimmoeller	Group A
03E01	Nano-Energetic Materials I	E. Dreizin	J. Puszynski	Group 3E
03D02	Functional Nanoparticles	Y. Xing	D. Deng	
03E03	Nano-Energetic Materials II	E. Dreizin	J. Puszynski	Group 3E
08E02	Nanoelectronic Materials	X-A. Fu	K. Ziegler	Group 8E
T5002	Nanomaterials for Hydrogen Production and Fuel Cells	Y. Joo		Topical Session
03D03	Nanoparticle Coatings & Nanocoatings on Particles	A. Weimer	X. Liang	
03D04	Nanostructured Particles for Catalysis	J.R. van Ommen	K. Deshpande	
03D05	Nanostructured Particles for Bio, Food and Pharma	M. Swihart	G. Sotiriou	
03D00	Processing and Handling of Nano- and Nanostructured Particles	B. Schimmoeller	K. Wegner	Group 3C

Group 3E: Energetics

Prof. Jan Paszynski (Chair) & Prof. Edward Dreizin (Co-chair)

Session ID	Session Title	Chairs	Co-Chair	Co-Sponsor
03E01	Nano-Energetic Materials I	E. Dreizin	J. Puszynski	Group 3D
03E03	Nano-Energetic Materials II	E. Dreizin	J. Puszynski	Group 3D
03E03	Processing and Safety of Energetic Materials	S. Prickett	J. Bolognini	
03E04	Thermophysical Properties of Energetic Materials	V. Boddu	P. Redner	
12B01	Process Scaleup Techniques	J. Salan	B. Hook	Group 12B
03E00	Advance On-Line Analytical and Optimization Tools in Pilot Plants	D. Attride	J. Salan	

Annual PTF Dinner, October 31, 2012

Ralph Nelson (PTF Service Award) with Ray Cocco and Jennifer Curtis

John Grace (PTF Award) with Jennifer Curtis

Mayank Kashyap (PTF Best PhD Award) with Jennifer Curtis

Jim Litster (Thomas Baron Award) with Jennifer Curtis

Xiaotao Tony Bi (Lectureship Award) with Ray Cocco and Jennifer Curtis

Photos of the PTF Dinner in Pittsburgh can be found at www.aicheptf.org

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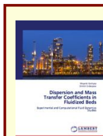
The PTF is now sponsoring job searches on the web. Need a career? Need an engineer? Go to http://www.aicheptf.org.

JOB POSTINGS ON THE WEB

The PTF is now posting jobs on their website at http://www.aicheptf.org/activities/career-opportunities. The most recent postings are

- Project Engineer for **CPFD-Software,**
- Research Engineering for **Particulate Solid Research, Inc. (PSRI),**
- Senior Engineer for **Cristal Global,**
- Bulk Solids Handling Consultant for **DuPont**, and
- Engineering Science Leader for **Dow Corning.**

Details on job requirements and how to apply can be found on the PTF website. If you have a position available, please send your job posting information to Ray Cocco at ray.cocco@psrichicago.com.



New Book! "Dispersion and Mass Transfer Coefficients in Fluidized Beds" by Mayank Kashyap & Dimitri Gidaspow, ISBN 978-3-659-22663-2. Click Here to Buy.

Have an idea or suggestion for an article in the PTF Newsletter, please let us know.