The PTF Newsletter

The Annual Meeting has a special significance for the [Particle Technology Forum](#) community, where we come together not just to share our research, but also to acknowledge and celebrate the achievements of our peers. This year is no different. In this issue, we have made an attempt to summarize the events during the meeting (as a mini-guide to the PTF activities). We hope that you find it useful. Additionally, AIChE has put out an excellent smartphone application to make conference navigation easier.

Our current newsletter format strives to strike a balance between the technical content and general communication for the membership. We look forward to hearing your suggestions and comments regarding the content and the format.

The countdown has begun…

Shrikant Dhodapkar, Dow Chemical Company

Ray Cocco, PSRI

In this issue…

L. S. Fan is Named AIChE's 67th Institute Lecturer

Prof. Liang-Shih Fan, Distinguished University Professor and the C. John Easton Professor in the Department of Chemical and Biomolecular Engineering at The Ohio State University, will present **AIChE'S 67th Institute Lecture** on November 11, 2015, at 11:15am-12:15pm MST during the Annual Meeting at SLC.

Karl Jacob is the Recipient of Lawrence B. Evans Award in Chemical Engineering Practice

Karl Jacob, a Fellow in Core R&D at The Dow Chemical Company, was awarded the Lawrence B. Evans award in recognition of his substantial lifetime achievement in industrial chemical engineering practice, including management, leadership, research, publications and technology development.

Letter from The Chair

It is that time of year again. We are only days away from the AIChE annual meeting with all the excitement and expectations. Putting the final touches on the contents, reviewing the slides with peers, rehearsing and timing the presentations with the advisors and team members and much more is going on in different parts of the world. As usual, employers will be looking for fresh talent and graduates will be looking for job openings. Everybody will be there to find new connections, fortify the old ones and catch up with friends. We will all be attending technical sessions, discussing and questioning new findings and exchanging ideas. Eventually the week will be over and fresh ideas will be generated and new paths may be found for ongoing projects. On the business side of the meeting, AIChE staff and volunteers are there to make sure all the expectations are met or even exceeded. Many business meetings will also be held to ensure seamless technical programing for next year, brainstorm ideas to serve current members better and attract more members.

PTF will also have its fair share of technical and business meetings. These are all listed elsewhere in this issue. If you are interested in helping with any aspects of the PTF, please make a note to attend any or all of these.

The PTF dinner is another event that you do not want to miss. Over 100 particle technology devotees gather to enjoy good food, chat with colleagues and celebrate peer accomplishments. Details about the PTF dinner are given in this newsletter. Please note that this is always a sold out event, so please register as soon as possible if you have not already done so.

As I mentioned in the summer letter, there are many tools, trainings and webinars that have been developed to help with various job functions and are available to members. Please take advantage of these and let us know if you have any comments, positive or negative.

Finally, in order to make your experience at the annual meeting even better, AIChE provides a free smartphone app. I personally used it last year and found it useful in many ways. It has many features such as search, schedule planning, meeting locations and most up to date information. Hope you also find it useful this year at the meeting and most importantly hope to see you soon in Salt Lake City. That is the real reward for all the volunteers.

Reza Mostofi

UOP, A Honeywell Co.

PTF Award Winners 2015

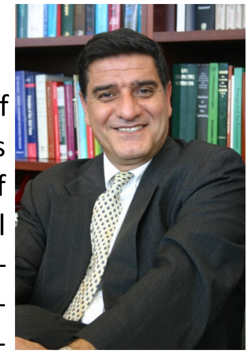
PTF Lifetime Achievement Award

Dr. John Carson, of Jenike and Johanson, is a solids handling expert with an international reputation developed over four decades of industrial practice and applied research. Over that time, John has built Jenike & Johanson into the premier bulk solids handling and processing consulting company in the world. He has over 140 publications across all facets of solids handling but has made seminal contributions in the areas of bin loads, structural design and limiting flow rates in hoppers and bins. But we should not measure John by his publications alone, as he is an expert consultant and is in his element when climbing around or in a silo! As an indication of John's commitment to the science of the field, he is one of the few consultants who routinely participates in major international conferences.

John is a member of the AIChE, ASME, and the ASCE. He was a founding member of the PTF. Beyond his U.S. contributions, John is among the few American participants in global solids handling groups such as the European Federation of Chemical Engineers (EFCE). His contributions have also been recognized by the IMechE in Britain, with their Solids Handling Award. He was a founding member (and current chair) of ASTM committee D-18.24, standardizing the characterization of bulk solids for handling purposes.

John places a high value on the training and mentoring of others. For many years, he was influential in the training of many engineers through both short courses and in-house courses. In addition, he took it upon himself to help Prof. Dietmar Schulze with the English translation of Schulze's 500 page definitive reference book, "Powders and Bulk Solids". Beyond initial teaching, John has served as a kind and generous mentor to dozens of industrial practitioners and has patiently reviewed countless manuscripts in the field.

Thomas Baron Award



Prof. Hamid Arastoopour, of Illinois Institute of Technology, is a pioneer in the development of the theory and mathematical model for flow of multi-sized particles with varying particle properties distribution, and the required CFO/PBE model and FCMOM (finite-sized domain method of moments) numerical technique. His research is considered to be one of the major contributions to the scale-up of pharmaceutical and energy conversion processes and has played a significant role in shortening the gap between laboratory-scale and commercial-scale processes. He is a highly prolific researcher, authoring more than 100 publications and 13 U.S. patents. Dr. Arastoopour's pioneering work on the development of a theory and governing equations (model) for the flow of multi-sized particles based on the kinetic theory, published in the AIChE Journal in 2005, is having a significant impact on the design of processes that include particles such as coal and solid waste gasification and drying and granulation of solid pharmaceutical products. The National Energy Technology Laboratory (NETL) has incorporated his theory and model for the flow of multi-sized particles in the DOE MFIX computational fluid dynamics (CFD) code that is being used for the design of clean coal gasification and separation of CO_2. His recent research on a new and innovative approach for prediction of particle size distribution variation in the fluid/particle and fluidized bed processes due to particle reaction, agglomeration, and breakage by linking population balance equations (PBE) with CFD represents a major step in enhancing our ability to design and simulate fluid/particle systems based on a fundamental approach. His approach includes using the method of moments in a finite-sized domain using a complete set of orthogonal functions (FCMOM). In his 2013 publication in Chemical Engineering Science, he demonstrated that his approach provides a highly efficient computational system.

PTF Award Winners 2015

PSRI Lectureship in Fluidization Award

Dr. Rajesh Dave has made ground-breaking contributions to the science of cohesive powder fluidization, particle contact modelling and fluid-particle processing for industrial and pharmaceutical applications. He has made major contributions to the field of fluidization by addressing the under-explored topic of the fluidization of Geldart Group C powders. He is a pioneer in developing fundamental model-based novel techniques for tuning Group C powders to behave like group A powders through dry coating based surface modification that leads to nano-rough surfaces. Building on the fundamental understanding of the two key parameters that govern the Group A/C transition, namely, the gravitational body force and cohesion, he focused on cohesion reduction, the more practical of two potential *tuning* parameters. The model-based explanation of cohesion reduction was first provided in the highly cited 2005 paper [Yang et al., *Powder Tech* 2005] that showed how the size of a surface asperity influenced the extent of cohesion reduction. This single-asperity model was extended to a multi-asperity model accounting for the nano-particle surface area coverage (SAC) in a well-cited paper [Chen et al., AIChE J, 2008] that showed that Group C powders can indeed be fluidized. This seminal work led to a practical demonstration of fluid-bed film coating and granulation of powders smaller than 15 microns. This work has now led to a commercial application in taste-masking of sub-50 micron bitter drug powders, fulfilling a major unmet need in orally disintegrating pharmaceutical dosage development. Fluidization via a cohesion reduction approach, as developed by Prof. Davé, is a major practical advance over the previous *status quo*, which focused on achieving a Group C/A shift through centrifugal force generated in a rotating fluidized bed. Prof. Davé has mentored many students and junior faculty and has granted a total of 26 PhDs, of which six are currently in US academia; dozens have received national awards.

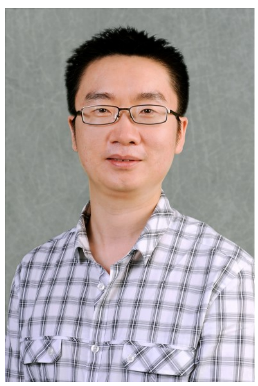
Fluidization Processes Recognition Award

Charles (Chuck) Hemler from UOP is recognized both within UOP and in the industry as an expert in the field of Fluidized Catalytic Cracking (FCC), being involved in several technology innovations and patents in addition to his numerous technical publications in the field. A chemical engineering graduate of the University of Notre Dame, Chuck retired from UOP as a Senior Fellow having spent more than 40 years contributing to research, development, engineering, and sales activities in support of the Fluid Catalytic Cracking (FCC) Process. He joined AIChE in 1964, started full time with UOP in 1969, and in his years at UOP contributed numerous literature articles, book chapters, patents, and technical presentations for the refining industry related to FCC. Later Chuck also served as the Vice-Chairman of the Executive Committee of PSRI (Particulate Solid Research, Inc.) and was one of three presenters when AFPM celebrated the 70th anniversary of the FCC Process. He is currently retired and resides with his wife in Mount Prospect, Illinois.

George Klinzing Best PhD Award

Dr. Maneesh Singh, Purdue University, completed his doctoral thesis under the guidance of Prof. Doraiswami Ramkrishna. He developed a framework which utilizes combinatorics to generate a graph of different morphologies connected by edges describing morphology transformations. He further demonstrated Morphology Domain as a fundamental property of crystals which can be used to screen crystallization conditions for the controlled synthesis of desired crystal morphologies that is both facile and readily usable. The methodology, illustrated in controlling crystal morphologies of Potassium Acid Phthalate using additives, paves the way for model-based control of shape control of crystallization processes. The stochastic model provides the first quantitative basis for observed dispersions in crystallization processes. A new technique was also developed for measurement of 3D crystal morphology and identification of its polymorph using tomographic images. Confocal Microscopy was used for the first time to obtain tomographic images of crystals that are coated with a suitable fluorescent dye. His contributions include an image-analysis program for rapid measurements of morphology distributions and a method to experimentally determine polar plots of growth rates and dissolution rates from the dynamic images of crystals obtained from hot-stage microscopy.

SABIC Young Professional Award



The newly established SABIC Young Professional Award recognizes an individual who has made outstanding and internationally recognized contributions to the field of particle technology, through innovation and breakthrough research, and service to the particle technology community, within seven years of obtaining the last degree. The first recipient of the award is **Dr. Fanxing Li,** North Carolina State University, for his original contributions to particulate reaction engineering, redox catalyst design, and their applications for sustainable, carbonaceous-fuel conversion and carbon-dioxide capture. Dr. Li is an Assistant Professor in the Department of Chemical and Biomolecular Engineering at North Carolina State University. He received his PhD in chemical engineering at the Ohio State University in 2009 under the direction of Prof. Liang-Shih Fan. He has published 38 journal articles and book chapters. He is also an inventor/co-inventor of 11 patents and patent applications. He has won numerous awards including the Best PhD in Particle Technology Award and the National Science Foundation CAREER Award.

AIChE Particle Technology Forum Student Workshop

Saturday, November 7, 2015
155C (Salt Palace Convention Center)

Presenters:

Reddy Karri (PSRI)
Ben Freireich (Dow Chemical)
Ruud van Ommen (TUDelft)
Ray Cocco (PSRI)
Mayank Kashyap (SABIC) - Chair

Continuing hugely successful series of student workshops for undergraduate students, the objective is to introduce the field of particle technology, and bring awareness about its importance and relevance to the modern Chemical Process Industry. Two sessions in succession will be offered -

Concepts and Applications in Fluidization and Solids Handling, 11:30 AM – 12:30 PM
This session will focus on the fun and exciting world of fluidization and solids handling, which includes several breakthrough technologies. A number of hands-on demonstrations, such as fluidization, hopper design, segregation, etc., will be used during the presentations.

Particle Synthesis and Nanoparticle Technology, 12:30 PM – 1:30 PM
This session will illustrate some of the advances in particle design and manufacturing, including those of bio- and nano-particles, and the applications that continue to change our markets.

Tutorial For Young Professionals

Solids Processing in the Chemical Industry: What They Don't Teach You at School !

George Klinzing & Shrikant Dhodapkar

Sunday, November 8, 2015

3:30 PM - 6:00 PM, Salt Palace CC - 254B

Covers various topics of interest to the Young Professionals—both technical and soft-skills

Evolution of Kinetic Theory of Granular Flow

Mayank Kashyap

Saudi Basic Industries Corporation (SABIC) Technology Center, Sugar Land, TX 77478, USA

Dimitri Gidaspow

Department of Chemical and Biological Engineering, Illinois Institute of Technology, Chicago, IL 60616, USA

Kinetic Theory of Granular Flow and Granular Temperature

The invention of kinetic theory of gases led to the application of the theory to mixtures about one and a half centuries ago (Chapman and Cowling, 1961). The observation of random motion of particles in liquid (Gidaspow and Jiradilok, 2009) led many researchers to realize the application of kinetic theory of gases to fluidization. However, quantitative predictions were not made until Professor Stuart Savage of McGill University, Canada, in the early 1980s (Savage, 1983) invented the *kinetic theory of granular flow (KTGF)*, by the introduction of dissipation energy through the use of restitution coefficients. The theory replaced the fudge factor in the kinetic theory of dense gases with the concept of radial distribution function of statistical mechanics for which an approximate expression is given by Bagnold's formula (Gidaspow, 1994).

Professor Savage introduced the concept of *granular temperature* while solving a simple free-surface granular flow down a rough inclined plane. Granular temperature, defined as the measure of random oscillations of particles, bubbles or clusters, is the backbone of KTGF. It is the average variance of fluctuating velocities in all the three directions, defined as $\theta = {}^{1}\!/_{3} < \sum C^2 >$, where, θ is the granular temperature; C is the fluctuating velocity in each direction. It is analogous to the conventional thermal temperature in the kinetic theory of gases, defined as $k_B T_g = {}^{1}\!/_{3}\, m_g < \sum C^2 >$, where, k_B is the Boltzmann constant; m_g is the mass of gas. Thermal temperature, T_g, can be converted to granular temperature by taking ${}^{k_B}\!/_{T_g} = 1$ in the formula of kinetic theory of gases. The temperatures of all the components of gas are equal, since molecules do not dissipate energy upon collision. However, granular temperature varies with particle size. Unequal granular temperatures were first measured and published by Huilin et al. (2001).

KTGF has been reviewed extensively in the literature since the invention of the theory (Sinclair and Jackson, 1989; Ding and Gidaspow, 1990; Gidaspow, 1994; Cody et al., 1996). Cody et al. (1996) were the first group to systematically measure granular temperature using quantitative analysis of the response of the wall of fluidized bed to random particle impact using the acoustic shot noise method. Campbell (1990) described the concept of granular temperature as the single most important parameter to understanding the behavior of fast granular flows.

Figure 1 shows that the granular temperature measured using particle image velocimetry (PIV) technique described in Kashyap (2010) can be approximated by a fourth order parabolic equation obtained by solving the granular temperature equation for elastic particles (Gidaspow and Arastoopour, 2011).

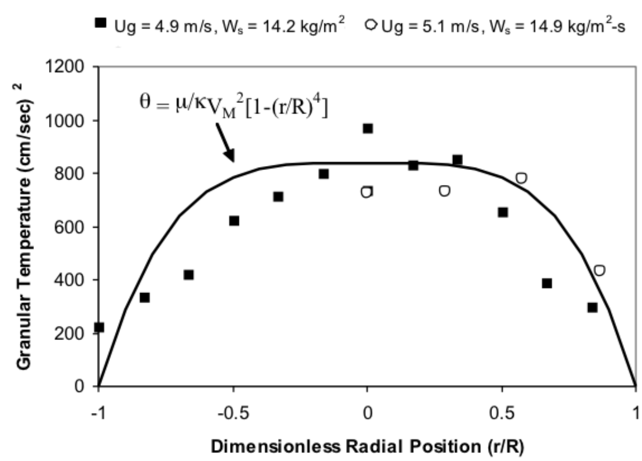


Figure 1. A comparison of measured granular temperature in the IIT two-story riser to the analytical solution (Tartan and Gidaspow, 2004)

Gidaspow et al. (2004) and Jung et al. (2005) defined and measured two types of granular temperature as:

"**Laminar**" type, due to the random oscillations of individual particles, is defined as the classical granular temperature. It is the measure of energy of the fluctuating velocity of particles defined as the average of particle normal stresses in all three directions. This granular temperature gives mixing on the level of particles.

"**Turbulent**" type, caused by the motion of bubbles or clusters of particles, is measured or computed by normal Reynolds stresses. It is due to the oscillation of bubbles or clusters of particles computed from the average of Reynolds stresses in three directions. This granular temperature gives mixing on the level of bubbles or clusters.

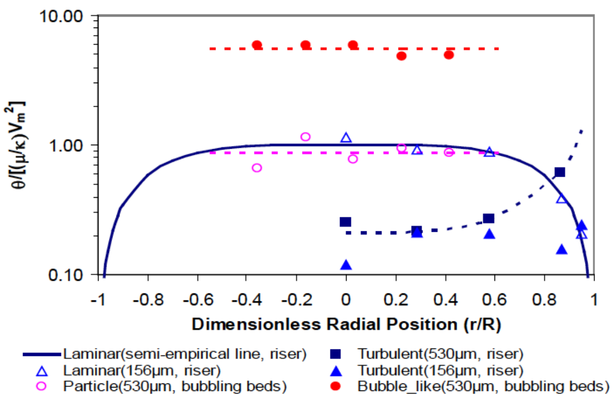


Figure 2. Measured dimensionless laminar and turbulent granular temperatures in the dilute phase riser and bubbling bed at IIT (Gidaspow et al., 2004)

Figure 2 shows the measured radial distributions of dimensionless granular temperatures for 156 μm and 530 μm particles in a dense bubbling bed and a dilute riser. The dimensionless turbulent granular temperatures for both particle sizes were much lower than the laminar granular temperatures in the center of the dilute riser tube, showing that the oscillations were on the level of particles, and not of clusters. These results agreed with the theoretical analytical solution for the granular flow equation for elastic particles shown in Figure 1. For the bubbling bed, the dimensionless turbulent granular temperatures were almost an order of magnitude larger than the laminar granular temperatures. Similar results were obtained by Kashyap et al. (2011) for Geldart D type particles in a dense riser. In general, the turbulent granular temperatures exceed laminar granular temperatures predicted by KTGF, in the commercial dense phase fluidized bed reactors.

Solids pressure can be measured or computed as a function of granular temperature using the particulate ideal state equation, $P_s = \rho_s \varepsilon_s \theta$, similar to the ideal gas law, $P_g = N_g k_B T_g$, where, ρ_s is the particle density; ε_s is the solids volume fraction; P_g is the gas phase pressure; N_g is the number of moles of gas. KTGF also shows how the transport properties, such as particulate viscosity, can be obtained from the measurements of random particle oscillation velocities.

Kinetic Theory Based Computational Fluid Dynamics

One of the major computational advancements made in the 1980s and 1990s was the use of Navier-Stokes (NS) equations to predict fluidization flow regimes (Gidaspow, 1994). In the past three decades, a number of two- and three-dimensional multiphase computational fluid dynamics (CFD) codes have been developed that couple the NS equations for each phase through the gas-solids drag. The codes use a fundamental concept of interpenetrating continua for multiphase mixtures, according to which different phases can be present at the same time in the same computational volume. The basic equations numerically solved for each phase in a CFD code for multiphase flow are the conservation of mass, momentum and energy, and constitutive equations.

It is critical to prescribe correct boundary conditions at the wall. A no-slip boundary condition at the wall is used for the gas phase velocities. While a no-slip boundary condition is used for the radial solids velocity at the wall, the Johnson and Jackson (1987) slip boundary condition is used for axial solids velocity. Johnson and Jackson (1987) granular temperature boundary condition obtained by equating the granular temperature flux for particles at the wall to dissipation due to inelastic collisions with a correction for slip, is used for granular temperature. Specularity coefficient is a fraction of total momentum transferred from particles to wall during collision, and is known to define the roughness of the wall. Specularity and wall restitution coefficients are prescribed as inputs to solve the granular temperature boundary condition at the wall.

CFD has recently become a significant and fundamental part of industrial and academic research to endorse engineering designs in single and multiphase flow systems (Jiradilok et al., 2006; Kashyap, 2010). The description of kinetic theory based CFD models in various forms is given in the literature (Gidaspow, 1994; Gidaspow and Jiradilok, 2009; ANSYS Fluent, 2015). It has been shown that the kinetic theory based CFD models are capable of successfully computing laminar hydrodynamic properties, such as laminar granular temperature by solving the conservation of fluctuating energy equation for particles, turbulent hydrodynamic properties, such as Reynolds stresses, turbulent granular temperatures, energy spectra, and dispersion coefficients (Jiradilok et al., 2006; Kashyap, 2010), and mass transfer coefficients (Kashyap and Gidaspow, 2012).

Several gas-solids drag models are available in the literature for multiphase CFD codes that range from the single particle drag force relationship (Wen-Yu, 1966) to the drag in packed beds (Ergun, 1952). The standard drag law for gas-solid interactions (Gidaspow, 1994), also known as the Gidaspow drag law in the commercial code, ANSYS Fluent (ANSYS Fluent, 2013), is a combination of the Ergun equation and Wen-Yu drag law. The Energy Minimization Multi-Scale (EMMS) interphase exchange coefficient or drag model (Yang et al., 2003) is a modification of the Wen-Yu drag law, and was developed using the concept of particle clusters.

The KTGF based CFD models are now available in commercial codes, such as ANSYS Fluent (ANSYS Fluent, 2013), and in the public domain, such as MFIX code developed at the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL). The kinetic theory approach in CFD has been extended to include particle rotation (Iddir and Arastoopour, 2005; Songprawat and Gidaspow, 2009), anisotropic flow using the method of moments (Strumendo et al., 2005), and continuous particle size distribution using population balances (Strumendo and Arastoopour, 2008).

Fluidization Flow Regimes

One of the major disadvantages of FCC risers is the coexistence of high concentration of downward flowing particles in the wall region, and a dilute core region through which most of the gas passes (Sinclair and Jackson, 1989). This flow regime is called core-annular regime. Solids volume fractions can be estimated by the drift flux theory (Gidaspow, 1994), in which buoyancy equals drag. Gidaspow and Jiradilok (2009) had shown that the core-annular regime is due to the radial distribution of gas-solids drag. The gas velocity is zero at the walls, hence, the wall layer cannot support the weight of the particles that reach there by turbulence. Sinclair and Jackson (1989) were the first group to analyze the gas-solids flows in a riser using KTGF, and compute core-annular regime. As shown in Figure 3, Kashyap et al. (2011) eliminated the undesirable core-annular regime by operating the Illinois Institute of Technology (IIT) riser under high gas velocity-high solids flux conditions, and termed the improved regime as anti core-annular regime.

Figure 4 summarizes the basic fluidization flow regimes computed using the CFD code developed at IIT. These regimes are well explained in fluidization books, such as Kunii and Levenspiel (1991) and Gidaspow (1994). Tsuo and Gidaspow (1990) were the first to compute particle clusters using estimated solids viscosity as an input to a CFD code, whereas, Neri and Gidaspow (2000) used the KTGF CFD code to compute similar cluster behavior.

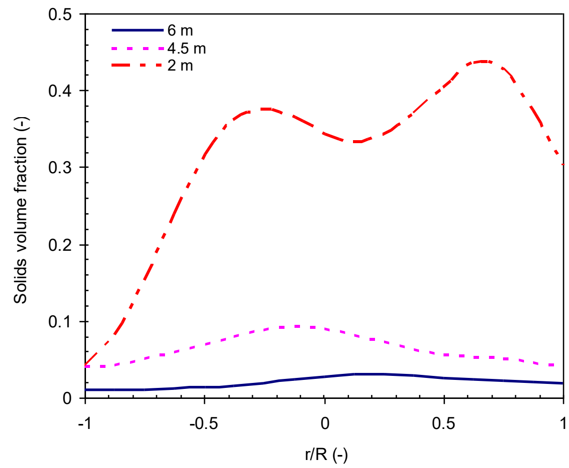


Figure 3. Radial distributions of solids volume fractions at three different heights in the IIT riser (Kashyap et al., 2011)

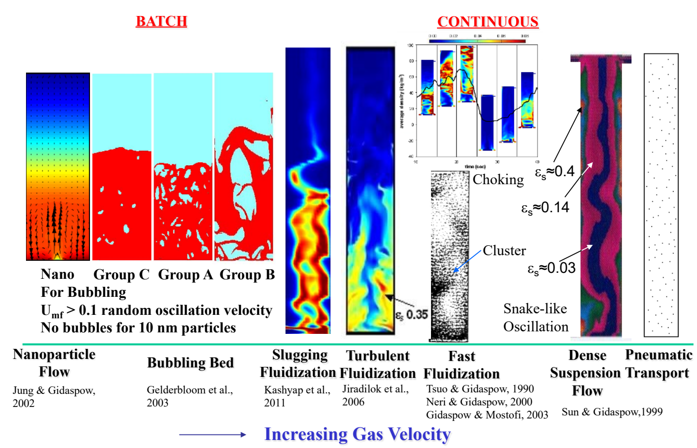


Figure 4. A summary of basic fluidization flow regimes computed at Illinois Institute of Technology (Gidaspow et al., 2004)

Jiradilok et al. (2006) showed that the turbulent fluidization flow regime, characterized by the co-existence of a dense bottom and dilute top, could be successfully computed using the KTGF based CFD code developed at IIT, similar to the computation of turbulent single phase channel flow using direct numerical simulation (DNS). Kashyap et al. (2011) presented the first known use of gamma ray densitometry to capture solids slugging phenomenon, and to model the flow regime using a kinetic theory based IIT CFD code with the standard gas-solids drag.

Recent Developments in KTGF

KTGF was recently applied to the computation of motion of platelets and red blood cells (RBCs) in blood vessels (Gidaspow and Chandra, 2014). The experimentally measured motion of platelets to the wall and RBCs to the center can be explained by KTGF due to unequal granular temperature. The platelets migrate towards the walls due to the high granular pressure produced by random oscillations of RBCs and dissipation of platelet random energy at the walls. Shear is highest at the walls, which produces a high granular temperature and pressure, driving RBCs towards the center. Benyahia (2008) reviewed the unequal granular temperature kinetic theory model described by Gidaspow and Jiradilok (2009), and incorporated it in MFIX.

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Opportunity for Full-time or Part-time Students:

- The program is intended for engineers, either newly graduated or with industrial experience, who want to develop their expertise in particle technology for industrial application.
- The program can be completed with full-time attendance in 12 months. Part-time students are also welcome, and classes are offered virtually via distance learning.
- The core of the program is six new courses in particle rate processes, transport, mathematics, properties & characterization, unit operations, and product design. Its capstone is an industrial internship in which the student applies classroom fundamentals to real world industrial problems.

Opportunity for Industrial Sponsors:

- We are looking to establish a broader network of internship partners throughout the U.S. and abroad with our program's capstone element.
- We are looking to establish a broader network of guest lecturers and invited speakers.
- To contact us or review more details about the MEPT program, please visit:

http://www.che.udel.edu/grad/MEngPT.html

Application Deadline for Partial Department Scholarship: March 1st

Particle Formation: The shape of things to come

Patrick T. Spicer

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Although particle size is still a common process control parameter (1) and product specification (2), shape is increasingly a goal of new material development. The importance of particle shape has long been recognized, often where undesirable variations in shape can reduce process efficiency. Examples include aggregation of nanoparticles that reduces quality of coatings and growth of elongated crystals that hinder filtration. The controlled production of non-spherical particles has always been a requirement of crystallization, while agglomeration processes commonly output very regular agglomerate shapes through careful process engineering (3). Clever sol-gel techniques were specifically developed in 1984 to produce regular geometric shapes like cubes (4), but never really found an application. Here I focus on newer methods of producing complex shapes in liquid dispersions.

Controlling particle shape is increasingly popular quite recently, as it has been shown to offer a number of advantages in areas like drug delivery. For example, spherical particles elongated above a certain aspect ratio are not well-engulfed by human white blood cells (5), enabling control over uptake of drug actives by altering particle shape. Other particles have been developed that mimic the shape of human red blood cells (6), reducing immune response and easing flow through blood vessels. Aerosol deposition of inhaled therapeutic fibrous particles is improved over compact shapes, improving transport to deep parts of the lung (7). Shape can also impact particle self-assembly (8), flow toward pipe walls (9), and suspension rheology (10).

This report discusses current research approaches to producing particles with controlled shape and asserts that these methods will adapt and become increasingly viable at large scale as the demand for shape control increases. It is hoped that the information reviewed here will provide a starting point for inquiries into shape control applications and methods.

An excellent overview of the many aspects of colloid shape and surface complexity is given by Glotzer and Solomon (11). They point out the incredible diversity of unusual and complex forms that can be produced by various synthesis methods. Key shape descriptors are identified, some familiar like faceting, roughness, and aspect ratio, as well as others like surface anisotropy and branching. Faced with a rapidly growing toolbox of shape control mechanisms, it is fascinating that we are only beginning to understand the effects of shape on particle applications. *As a result, we lack a strong large-scale demand for any particular shape and instead tend to study fairly simple, Platonic shapes…even when we can produce far more unusual forms.* As shape control and our understanding of what shape can do for our applications improves, the demand will increase. A similar development occurred when monodisperse polymer particles became available (12), enabling research studies with an unprecedented level of accuracy but also large-scale production for use in paints and other coatings. A Google Patent search for "controlled OR control particle shape" yielded roughly 1,000 results, while a search for "controlled OR control particle size" produced 10,000 results. An opportunity exists.

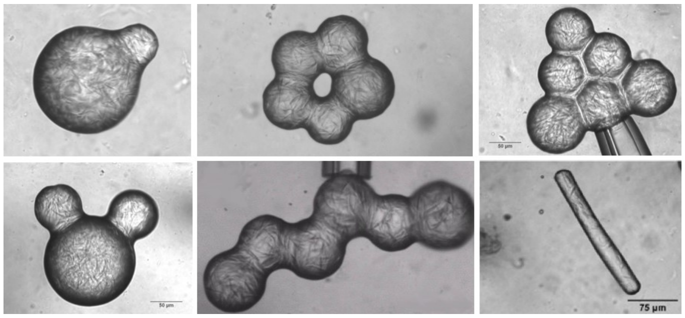
A modern adaptation of controlled crystallization methods has enabled a number of nanoscale shapes to be synthesized (13).

Microfluidic techniques are attractive for particle synthesis because of their extreme monodispersity, but their low flow rates limit production to, at most, kilograms per day. Stop-flow lithography is a technique used to selectively polymerize monomer in a microfluidic channel and form shaped colloids (14). Two-dimensional masks determine the shapes produced, yielding a flattened particle with the outline of the mask shape extended by some depth.

The PRINT technique uses microscale molds formed on flexible films, allowing continuous production of larger amounts of shaped particles with excellent monodispersity of size and shape (15). Again, the mold shapes tend to vary only in two dimensions.

In an exciting new research direction, evolutionary algorithms are being applied to the design of granular particles with optimized packing and flow properties. Simulations start with an initial shape, assess flowability, and then feedback stimuli to adjust the shape and optimize particle performance (16).

While most shape research examines solid particles, the use of complex rheology means even liquid droplets can stably adopt non-spherical shapes and be used as a design platform for rapid improvement and adaptation of shape for numerous applications (17-18). The following figure shows images of droplets with an internal yield stress, allowing flexible shape molding and assembly, retention of a liquid surface, and enhanced chemical encapsulation and delivery.



Shape is a frontier of particle formation and the more we learn about the benefits of shape the more we will be inspired to produce increasingly complex shapes, someday achieving the level of complexity seen in nature for "particles" like pollen, cells, diatoms, and seeds.

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New Ideas for PTF Newsletter ?

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Profiles in Excellence

Wai Kiong Ng

Program Manager (Specialty Chemicals) & Team Leader
Institute of Chemical & Engineering Sciences, Singapore Agency for Science, Technology & Research (A*STAR) &
Adjunct Assistant Professor,
Department of Pharmacy,
National University of Singapore
Research Page

Wai Kiong and his formulation sciences team are developing scientific knowledge of the necessary raw materials, of their preparation and processing into the optimal form for commercial applications. Their research interests are in novel particle systems - amorphous solid dispersions via co-milling, co-precipitation using supercritical CO_2, hot melt extrusion, mesoporous carriers and nanoformulations. They also aim at improving powder processing such as micronization, granulation, powder flow, fluidization, spray drying and using in-line process analytical technologies like PVM (microscopy), PBRM (laser backscattering), NIR (near infra-red) and acoustics emission.

Their goal is to translate these findings to the commercial world by collaborating with pharmaceutical, specialty chemicals and consumer care companies. For example, some of his patents are about developing mesoporous excipients to enable high drug loadings for bioenhancement, target delivery, controlled and sustained release. Due to the nanostructured carrier pores, the drug molecules are confined and stabilized within the nanochannels in a metastable amorphous (non-crystalline) state, which improves dissolution properties for enhanced bioavailability. The particle surface can be further functionalized to create interactions with drug molecules for targeted drug delivery and designed release profiles.

He was given the PTF best paper (Group 3a) award in 2008, and has been active in **Group 3a (Particle Production & Characterization)** programming. He has received GlaxoSmithKline-Economic Development Board (GSK-EDB) green and sustainable manufacturing awards (2010 & 2011) and Institution of Chemical Engineers (IChemE) Singapore pharmaceutical and specialty chemical award (2012). His PhD students, Dr. A. Saigal and S.H. Lee have recently won the grand prize at the International Society for Pharmaceutical Engineering (ISPE) Singapore Student Poster Competition (2014 & 2015).

A.-H. Alissa Park

Director of the Lenfest Center for Sustainable Energy, The Earth Institute
Associate Professor,
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Columbia University, NY
Research Page

A.-H. Alissa Park is the Lenfest Chair in Applied Climate Science of Earth and Environmental Engineering & Chemical Engineering at Columbia University in the City of New York. She is also the Director of the Lenfest Center for Sustainable Energy at the Earth Institute. Her interdisciplinary research focuses on carbon capture, utilization and storage (CCUS), and sustainable energy conversion pathways with emphasis on innovative materials and reaction schemes based on the principles of particle technology and advanced carbonate chemistry. The current research efforts of Park's group include fundamental studies into the cutting-edge of CCUS by developing novel nano-scale materials for combined CO_2 capture and conversion to chemicals, and better carbon utilization and storage options involving earth abundant minerals. Founded on these new materials and reaction schemes, Park's research group is also working on innovative fuel synthesis pathways using unconventional energy sources such as shale gas, biomass and municipal solid wastes, while minimizing environmental impacts. Park received a number of professional awards and honors including the NSF CAREER Award in 2009 and James Lee Young Investigator Award in 2010. She is currently leading the NSF-funded Research Coordination Network on Carbon Capture, Utilization and Storage (www.ccusnetwork.org).

Her research work also includes the investigation of electrostatic charging phenomenon in multiphase flows, which is one of the fundamental challenges faced by many industries including the ones in energy and chemical sectors. Thus, she regularly consults and collaborates with industrial partners (e.g., steel-making industries) to provide further insight into the particle-particle interactions, entrainment behaviors, and particle mixing for the highly charged particulate systems.

She serves in many leadership positions including the executive committee member and treasurer of the PTF. She was the chair of **PTF Group 3b Fluidization & Fluid-Particle Systems** (2011-2013) and a member of the Societal Impact Operating Council (2008-2013), and serves as the vice chair (2015-2016) and chair (2017) of the International Committee at the AIChE. Her editorial work includes the Co-Specialty chief editor of *Frontier Research in Energy – Carbon Capture, Storage and Utilization* and an associate editor of *Energy and Fuels* and *Frontiers of Young Minds*.

From Practitioner's Desk

A challenging retrofit with interesting consequences

Lyn Bates, Ajax Equipment, UK

A steel making plant required coking coal supplied from four banks of ovens that were fed in sequence by four coking cars on parallel tracks. The coking cars were filled from a 4,000 Te. capacity hopper with four outlets in line. Despite causing intermittent impediments to production, long-standing arching and rat holing problems were tolerated by the organisation until an operator was injured using a long pole to stimulate flow. Health and safety concerns dictated that more reliable flow was secured. The age, construction and geometry of the installation prohibited the prospect of converting the total flow pattern from funnel flow to mass flow, in fact the flow channel could not safely be expanded to touch the walls because they were considered too weak to withstand a 'kick stress' resulting from a change from active to passive flow pressures. The nature of the coal was such that an extended residence time was not an issue, so the basic need was to prevent the formation of arches and ratholes.

The orifice size and location could not be altered, but the major improvement in flow characteristics given by a local mass flow at the outlet section, compared with funnel flow, was seen as sufficient to overcome the intermittent flow stoppage that was being experienced. A modification from 'Funnel' to 'Expanded Flow' was therefore undertaken by Ajax Equipment Ltd to change the construction of the hopper in the lower regions. This mode of flow would overcome the arching problem. The second task of preventing ratholes required the flow channels to be expanded to a cross section to be larger than the 'critical rathole diameter', but not to extend it to the size of reaching the hopper walls. Whereas this would normally require the size to be developed to an extent that compromised the storage capacity of the installation and be costly, the fact that the four outlets were inline meant that expanding the flow channel sideways to the size of the outlet centre distance would cause them to overlap and give an effective size of flow channel spread across four centre distances, massively greater than any potential rathole diameter. The mass flow discharge pattern from the outlet was secured by installing a hopper section that expanded in one plane only to a slot in line with the outlet centres. A subsequent transverse section with insert continued the mass flow a short distance, above which shallow faces were installed back to the original hopper walls to provide a self-clearing surface.

Following tests on samples of the coal and a model demonstration, (for the benefit of sceptical clients), a design was produced that had sequential plane flow transformations from the outlet to a steep pyramid section built up in 2B-Finish Stainless Steel at a lower wall inclination than the original cement walls.

The insert was constructed to satisfy two objectives. The main purpose was to secure wall slip in the pyramid section by enlarging the flow channel, which avoided having to make steeper walls that would involve much expense and encroach on the hopper storage capacity. A second function was to encourage faster discharge. It is well known that discharge through the same size outlet in mass flow takes place at a lower flow rate than in funnel flow. To avoid extending the fill time of the choke oven charging cars, the insert allows the peripheral regions of the mass flow section to converge with less resistance from the central 'core' region of the flow channel and pass through the outlet quicker. The resulting cavity was to be back-filled with low density concrete. The installation was effectively completed by experienced rock climbers suspended on ropes within the cavernous structure.

Although the construction was consistent on the four sections to each of the outlets, three sections worked perfectly, but occasional arching and rat holing was experienced on one section. The mystery was solved when the hopper contents were run down to a low level. Leakage of the back-filling concrete onto the internal surface had dried as a rough film on the stainless surface, inhibiting slip of the coal as intended. Once this was cleaned off, production was uninterrupted. However, some months later it was noticed that the expanded flow channel above one of the outlets was considerably larger in diameter at the surface of the hopper contents than that of the other three.

An examination discovered that a local section of lining had pulled away from the wall and had bent out to partially obstruct flow at cross-section where the remaining area could not arch. The resulting flow divergence enhanced the cross section of the flow channel. Despite this, the liner was repaired as the performance was totally satisfactory and the installation has since been entirely trouble free. Based on these results a second installation of similar size was successfully modified and a third contemplated, but deferred due to a collapse in the market for steel.

Bulk Solids Innovation Center

Kansas State University

Todd Smith, VP Global Systems

Coperion K-Tron, Inc.

The goal of the Kansas State University Bulk Solids Innovation Center (BSIC) is to improve our understanding of bulk solids behavior and increase the state of technology for handling and processing bulk solids.

This Center is the only one of its kind in North America, led by the University, but relying on industry partners. It was completed in May, 2015 at a cost of over $5M. Government support was a key factor, with Federal, State, and Local grants contributing much of the facility cost. All equipment was donated by industry – 25 companies donated $2.5M of equipment, with the goal of making this the most advanced facility in the world for studying bulk solids handling and processing. It has every type of pneumatic conveying, multiple valves, feeders, storage hoppers of various geometries, and several types of particulate air filtration. It has a full sized silo with variable discharge geometry and flow aids. It can accommodate materials received by rail, truck, box, drums, bags or bulk bags. Long distance conveying, up to 920 ft horizontal and 65 ft vertical, can be achieved.

K-State is responsible for coordinating research at the BSIC. They already have commitments from several companies, and are expecting research projects in the areas of bulk solids handling, conveying, blending, segregation, flowability, degradation, gravity flow, particulate air filtration, storage, etc. In addition, the Center has state-of-the-art controls interfaces, monitoring, and data acquisition of all parameters. Real-time data from hundreds of sensors can be used to evaluate signals about pressure, temperature, flow rate, velocity, amperage, power consumption, weight, and time. The data is stored on a server from which raw data, trending information, and graphs can be displayed. Does the computer model portray actual behavior of bulk solids in the real world? The Kansas State University Bulk Solids Innovation Center hopes to help make sure that happens.

In addition to the Full-Scale Lab, the Center has several smaller laboratories containing a full range of advanced material analyzers for bulk solids. K-State will provide independent material testing services. Therefore, companies can send material samples to the Center to get an independent evaluation of material properties and recommendations.

K-State will also coordinate education at the BSIC. Professional Development/Continuing Education short courses will be offered to industry personnel beginning this year. Anticipated courses include bulk solids material handling, conveying technology, gravity flow, feeding and weighing, industrial control, troubleshooting pneumatic conveying systems, etc. These courses will help industry personnel understand and improve the performance of bulk solids and the systems that handle them.

Students will receive lecture information from industry and academic experts, then step into the adjacent labs to measure properties and try bench-scale analysis, then step into the Full-Scale Lab to run the bulk solids in hands-on mode with real equipment.

For college students, KSU will be developing a Bulk Solids course of study within the college of Engineering and Applied Technology. Students will attend courses on bulk solid properties, and explore how changing the material characteristics affects the behavior. Process design courses will include size reduction, mixing and de-mixing, particulate air filtration, and design of material handling systems.

Continued financial support of the Center will be provided in an unusual way. Instead of relying on government support which can ebb and flow, the KSU-Bulk Solids Innovation Center will rely on industry to provide the day to day maintenance and repairs in the facility. Industry will also cover overhead expenses such as utilities, housekeeping, grounds-keeping, and even consumable supplies such as coffee and toilet paper. In addition, industry is responsible for ongoing equipment needs including installation, controls programming, maintenance, repairs, and upgrades. It is believed that this unique partnership provides the best chance for a Center that can be sustained for many years.

The primary contact for the Center is Dr. John Lawrence, Kansas State University Research Director for the Bulk Solids Innovation Center.

Recent Awards and Honors

Dr. Shrikant Dhodapkar, of The Dow Chemical Company, was elected as a Fellow by the AIChE Board of Directors in July 2015. This election recognizes his considerable contributions to the AIChE, Dow Chemical and the greater particle technology community over the last 25 years. Shrikant has been an ardent volunteer on behalf of both the PTF and AIChE. He is currently R&D Fellow in Performance Plastics Research at The Dow Chemical Company. He is a recognized expert in particulate processes and solids handling, and recipient of more than 10 Dow Technology Awards. He is the past chair of PTF and current editor of the PTF Newsletter.

Dr. Bruce Hook of Dow's Industrial Solutions R&D in Freeport, Texas, was named a Fellow at American Institute of Chemical Engineers (AIChE) in July 2014. He serves as Industrial Liaison to the PTF Executive Committee, on the AIChE Academy curriculum development committee, and on the RPI Chemical Engineering Industrial Advisory Board. Currently R&D Fellow at Dow, Bruce is a recognized expert in process development and improvement, as well as particle technology and solids processing.

PTF Membership

To continue receiving the PTF newsletters (3 issues per year) and stay current with particle technology events and news, please make sure to renew/start your membership by either:

- Checking Particle Technology Forum when renewing your AIChE membership annually.
- Become a PTF lifetime member so that you don't have to renew membership every year.

Become a PTF only member (annual $15, **lifetime $150**)

Visit website: http://www.aiche.org/community/divisions-forums/ptf

If you don't see the PTF membership in your renewal screen, you can choose "Update Membership Options" and add PTF to your order.

You can also contact AIChE customer service at 800-242-4363 (US); +203-702-7660 (Outside the US); or email customerservice@aiche.org for membership questions and help.

PTF Membership Committee

Annual Meeting - Salt Lake City 2015

Business Meetings:

Meeting	Date/Time	Location
Executive Committee Meeting	Sunday, November 8, 2015 6:00 PM-7:30 PM	Salon B (Salt Lake Marriott Downtown at City Creek)
General Business Meeting	Monday, November 9, 2015: 6:00 PM-7:00 PM	253B (Salt Palace Convention Ctr.)
Area 3A Meeting	Wednesday, November 11, 2015: 5:50 PM-6:30 PM	255A (Salt Palace Convention Ctr.)
Area 3B Meeting	Wednesday, November 11, 2015: 5:50 PM-6:30 PM	254C (Salt Palace Convention Ctr.)
Area 3C Meeting	Wednesday, November 11, 2015: 5:50 PM-6:30 PM	254B (Salt Palace Convention Ctr.)
Area 3D Meeting	Wednesday, November 11, 2015: 5:50 PM-6:30 PM	255D (Salt Palace Convention Ctr.)
Area 3E Meeting	Wednesday, November 11, 2015: 5:50 PM-6:30 PM	255E (Salt Palace Convention Ctr.)

Particle Technology Forum Dinner

Date: November 11, 2015 (Wednesday)

Time: 6:30 pm—10 pm

Location: FINCA

Address: 327 W 200 S, Salt Lake City, UT 84101

Website: www.fincaslc.com

Dinner Ticket: $85

Directions From Salt Palace Convention Center:

Head south on 300 W toward W 100 S (0.2 miles) then Turn right onto W 200 S. Destination on left after 300 ft.

2015 Annual Meeting - PTF Sessions

Sunday, November 8

Late PM

13 Characterization and Measurement in Powder Processing
3:30 PM-6:00 PM, Salt Palace CC: 254C

14 Control and Optimization of Particle and Solids Production
3:30 PM-6:00 PM, Salt Palace CC: 254A

34 Solids Handling and Processing in the Chemical Industry: What They Don't Teach You at School
3:30 PM-6:00 PM, Salt Palace CC: 254B

Monday, November 9

Morning

49 Applications of Engineered Structured Particulates
8:30 AM-11:00 AM, Salt Palace CC: 254A

65 Dynamics and Modeling of Particulate Systems I - Granular Dynamics and Cohesion
8:30 AM-11:00 AM, Salt Palace CC: 254B

70 Fundamentals of Fluidization I
8:30 AM-11:00 AM, Salt Palace CC: 254C

98 Undergraduate Research Forum I: Energy and Environment
8:30 AM-11:00 AM, Salt Palace CC: Ballroom H

Early PM

116 Agglomeration and Granulation Processes
12:30 PM-3:00 PM, Salt Palace CC: 254A

134 Dynamics and Modeling of Particulate Systems II: Fluid-Particle Interactions
12:30 PM-3:00 PM, Salt Palace CC: 254B

140 Fundamentals of Fluidization II
12:30 PM-3:00 PM, Salt Palace CC: 254C

Late PM

201 Dynamics and Modeling of Particulate Systems III - Two Fluid Modeling and Applications
3:15 PM-5:45 PM, Salt Palace CC: 254B

207 Fundamentals of Fluidization III
3:15 PM-5:45 PM, Salt Palace CC: 254C

226 Population Balance Modeling for Particle Formation Processes: Nucleation, Aggregation and Breakage Kernels
3:15 PM-5:45 PM, Salt Palace CC: 254A

237 Undergraduate Research Forum III: Classical Chemical Engineering/Other Special Topics

3:15 PM-5:45 PM, Salt Palace CC: Ballroom H

Annual Meeting - PTF Sessions

Tuesday, November 10

Morning

278 Characterization of Engineered Particles and Nanostructured Particulate Systems
8:30 AM-11:00 AM, Salt Palace CC: 254C

310 Particle Breakage and Comminution Processes
8:30 AM-11:00 AM, Salt Palace CC: 254A

319 Special Session: To Celebrate Prof. John Chen's Career Long Accomplishments
8:30 AM-11:00 AM, Salt Palace CC: 254B

Early PM

367 Particle Technology Awards Lectures
12:30 PM-3:00 PM, Salt Palace CC: 254B

Late PM

394 Crystallization Process Development
3:15 PM-5:45 PM, Salt Palace CC: 155D

398 Dynamics and Modeling of Particles, Crystals and Agglomerate Formation
3:15 PM-5:45 PM, Salt Palace CC: 254A

412 Mixing and Segregation of Particulates I
3:15 PM-5:45 PM, Salt Palace CC: 254B

442 Poster Session: Particle Technology Forum
6:15 PM-8:00 PM, Salt Palace CC: Ballroom F

443 PTF Student Poster Award
6:15 PM-8:00 PM, Salt Palace CC: Ballroom F

Wednesday, November 11

Morning

447 Advances in Fluid Particle Separation
8:30 AM-11:00 AM, Salt Palace CC: 252A/B

474 Industrial Application of Computational and Numerical Approaches to Particle Flow I
8:30 AM-11:00 AM, Salt Palace CC: 254C

479 Mixing and Segregation of Particulates II
8:30 AM-11:00 AM, Salt Palace CC: 251E

489 Particle Engineering as Applied to Pharmaceutical Formulations I
8:30 AM-11:00 AM, Salt Palace CC: 254A

490 Particle Technology Research in the Asia Pacific Region: From Fundamentals to Applications in Energy, Material Synthesis & Processing, and Environmental Sustainability I
8:30 AM-11:00 AM, Salt Palace CC: 254B

2015 Annual Meeting - PTF Sessions

Wednesday, November 11

Early PM

526 Engineered Composite Particulate Systems for Pharmaceutical Active Ingredient Delivery
12:30 PM-3:00 PM, Salt Palace CC: 254A

537 Industrial Application of Computational and Numerical Approaches to Particle Flow II
12:30 PM-3:00 PM, Salt Palace CC: 254C

550 Particle Engineering As Applied to Pharmaceutical Formulations II
12:30 PM-3:00 PM, Salt Palace CC: Ballroom D

551 Particle Technology Research in the Asia Pacific Region: From Fundamentals to Applications in Energy, Material Synthesis & Processing, and Environmental Sustainability II
12:30 PM-3:00 PM, Salt Palace CC: 254B

Late PM

573 Biomass Processing and Handling - A New Frontier
3:15 PM-5:45 PM, Salt Palace CC: 254C

599 Nano-Energetic Materials I
3:15 PM-5:45 PM, Salt Palace CC: 254A

611 Special Session: To Celebrate Prof. John Grace's Career Long Accomplishments
3:15 PM-5:45 PM, Salt Palace CC: 254B

Thursday, November 12

Morning

643 Functional Nanoparticles
8:30 AM-11:00 AM, Salt Palace CC: 254B

655 Nano-Energetic Materials II
8:30 AM-11:00 AM, Salt Palace CC: 254A

659 Particle Formation and Crystallization Processes from Liquids, Slurries, and Emulsions
8:30 AM-11:00 AM, Salt Palace CC: 155D

666 Solids Handling and Processing I - Powder Flow
8:30 AM-11:00 AM, Salt Palace CC: 252A/B

667 Special Session: To Celebrate Robert Pfeffer's Career Long Accomplishments
8:30 AM-11:00 AM, Salt Palace CC: 254C

Early PM

690 Fluidization and Fluid-Particle Systems for Energy and Environmental Applications I
12:30 PM-3:00 PM, Salt Palace CC: 254C

699 Nanoparticle Coatings & Nanocoatings on Particles
12:30 PM-3:00 PM, Salt Palace CC: 254B

708 Solids Handling and Processing II - Continuum Behavior
12:30 PM-3:00 PM, Salt Palace CC: 252A/B

714 Thermophysics and Reactions in Energetic Materials
12:30 PM-3:00 PM, Salt Palace CC: 254A

2015 Annual Meeting - PTF Sessions

Thursday, November 12

Late PM

737 Fluidization and Fluid-Particle Systems for Energy and Environmental Applications II

3:15 PM-5:45 PM, Salt Palace CC: 254C

738 Gas-Solid Transport and Separations

3:15 PM-5:45 PM, Salt Palace CC: 252A/B

742 Nanostructured Particles for Catalysis

3:15 PM-5:45 PM, Salt Palace CC: 254B

753 Thermophysics and Reactions in Energetic Materials II

3:15 PM-5:45 PM, Salt Palace CC: 254A

Friday, November 13

Morning

754 Circulating Fluidized Beds and Measurement Techniques in Fluid-Particle Systems

8:30 AM-11:00 AM, Salt Palace CC: 254A

760 Nanostructured Particles for Energy Conversion and Storage

8:30 AM-11:00 AM, Salt Palace CC: 254B

Special Sessions

319 Special Session: To Celebrate Prof. John Chen's Career Long Accomplishments

Tuesday, November 10, 2015

8:30 AM-11:00 AM, Salt Palace CC: 254B

611 Special Session: To Celebrate Prof. John Grace's Career Long Accomplishments

Wednesday, November 11, 2015

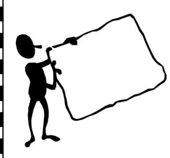
3:15 PM - 5:45 PM, Salt Palace CC: 254B

667 Special Session: To Celebrate Robert Pfeffer's Career Long Accomplishments

Thursday, November 12, 2015

8:30 AM - 11:00 AM, Salt Palace CC: 254C

New Poster Session



In an effort to increase attendance and interest, groups that have Poster Sessions from 6-8 pm on Tuesday night have chosen to move their poster session to 3:15 pm on Tuesday. PTF decided to keep the 6-8 pm time slot due to a large number of consecutive sessions on Tuesday afternoon. To accommodate the posters, AIChE assigned a ballroom to PTF. **This year the posters will be in a smaller venue than the one we are accustomed to.** We hope that this will promote interactions between the poster presenters and attendees, and also increase attendance. Also, new this year, are **short introductory oral presentations by our student poster contestants before they display their posters**. This will facilitate the selection of the best poster by our judges and will give the audience a chance to quickly overview the content of the posters.

Annual AIChE Meeting Best Paper Program

Enhancing the Editorial Content of AIChE Journal

OBJECTIVE: Attract the best presented contributions from the Annual AIChE Meeting to the *AIChE Journal* as archived manuscripts.

CONCEPT: The Annual AIChE Meeting continues to attract top chemical engineering researchers from across a spectrum of science and engineering areas. With this initiative, which was piloted at the 2012 Annual Meeting, the editorial team of *AIChE J.* seeks to identify and to invite the best contributors (presenters) at the Annual Meeting to publish their research findings in the *AIChE Journal*. To make this an annual success requires a team effort involving all of the Session Chairs at the Annual AIChE Meeting.

APPROACH: The *AIChE J.* editorial office will contact the session chairs DIRECTLY to get their nominations for the best presentation in their session within a week after the end of the meeting. This contact is an important aspect of the program as the *AIChE Journal* editors will be sending a strong message to the most active of chemical engineering researchers, who have taken the initiative to organize a session; namely, that the *AIChE Journal* is reaching out to attract the best works to the Institute's premiere research journal.

Upon receiving the nominations, the editorial office of *AIChEJ.* will invite ALL nominees to submit their papers to *AIChE J.*, while alerting these prospective authors that they are in the distinct group of "best papers" as identified by the session chairs.

All submitted papers will go through the standard rigorous peer-review process of *AIChE J.* Upon a paper being accepted, a note will be added in its Acknowledgments stating that the paper was nominated by session chair (name & affiliation) as the best paper presented in that session of the 2015 Annual Meeting in Salt Lake City. That way the session chair who made that judgement call is recognized as well as the programming area and Annual Meeting.

The 2015 Annual Meeting in Salt Lake City will be the fourth year of this initiative. We appreciate all of the help from participating Session Chairs and hope to build momentum of making this program a success!

PROCEDURE: The process starts with this email alerting Session Chairs of this initiative. Just before the Annual Mtg. a reminder will be sent to all Session Chairs to send their selections to Nicolette Solano (Editorial Assistant of *AIChE Journal* aiche.journal.asst@gmail.com) shortly after the meeting, identifying the "best paper" from their session [paper number, paper title, presenter's name &, email address]. Upon receipt of each nomination, an email will be sent out from Mike Harold (Editor-in-Chief of *AIChE J.*) to the presenters to submit his/her paper to *AIChE Journal* attaching its guidelines or link to *AIChE J.* webpage. By late-November a "thank you" e-mail is sent to all session chairs recognizing by name and affiliation everyone who nominated an outstanding presentation and copying every other chair. Submitted papers will then be reviewed through the normal editorial process.

If there is any question, please contact -

Sotiris Pratsinis (Associate Editor, ETH Zurich; sotiris.pratsinis@ptl.mavt.ethz.ch) or

Mike Harold (Editor, U. of Houston; mharold@uh.edu).

Job Posting

New Jersey Center for Engineered Particulates (NJCEP)

Two postdoctoral positions are available in Chemical Engineering at NJIT within the **New Jersey Center for Engineered Particulates (NJCEP).** A Ph.D. in Engineering or Science with research experience and expertise in one or more of the following fields is required: Particle Science and Engineering including Nanotechnology, Pharmaceutical Product Development and Technology, and Computational Modeling. We are looking for self-motivated, hands-on individuals with excellent command of the English language, both written and oral, and having a strong publication record that includes several first-authored journal papers. These positions require ability to work with a diverse group of students, postdocs and faculty working on the research projects involving experimental and modeling of structured organic particulates. The first position is concerned with developing a fundamental understanding of the impact of raw materials and processing on the quality attributes of the functionalized and surface modified pharmaceutical powders and their final dosage forms such as tablets and capsules via batch and continuous processing. The second position requires an expert in mathematical and computational modeling with familiarity with methods such as the discrete element method, population balance modeling and other dynamical approaches in fluid-particle systems. The person will lead the development, calibration, and validation of mathematical and computational models for various particle processes and their scale up, while incorporating experimental results and carrying out sensitivity analysis with simulations and identifying critical material–process-scale up parameters.

If you are interested and qualified, please send your CV with a list of journal papers, US visa status, the date of availability, and a one-page statement of research interests to both Profs. **Rajesh N. Dave (dave@njit.edu) and Ecevit Bilgili (bilgece@njit.edu).**

Have an idea for an article or suggestions for the PTF Newsletter ?
Please let us know:
Shrikant Dhodapkar sdhodapkar@dow.com
Ray Cocco Ray.Cocco@psrichicago.com

Upcoming Conferences

Fluidization XV

A ECI Conference Series

May 22-26, 2016
Fairmont Le Chateau Montebello
Quebec, Canada

Abstract submission now open!

The XV Fluidization Conference welcomes delegates from academia, industry and government who share the vocation to meet societal needs, reduce the environmental footprint of our processes, while at the same time forging new business models to meet the needs of the growing global population. To meet these challenges, we bring together experts in fields beyond fluidization and powder technology and include theoreticians in computational fluid dynamics (a transverse application), nano-processing and materials, catalysis, and biopharmaceuticals.

www.engconf.org/16af

Gordon Research Conferences

Granular Matter

July 24-29, 2016

Location: Stonehill College, Easton, MA

Application Deadline: **June 26, 2016**

Treasurer's Report

NY ACCOUNT	Starting	Income	Expenses	Balance
sponsor check from ANSYS (02/03/2015)		$1,160.00		$6,762.74
sponsor check from Jenike (02/03/2015)		$2,000.00		$8,762.74
JCurtis - cost for plaques (02/05/2015)			$287.00	$8,475.74
HOSTMYSITE.COM (04/02/2015)			$131.88	$8,343.86
sponsor check - University of Pitt (05/07/2015)		$660.00		$9,003.86
EIG*BLUEDOMINO (06/01/2015)			$107.40	$8,896.46
Shrikant Dhodapkar - MS Publisher (07/2015)			$108.24	$8,788.22
Totals as of 10/2015	$5,602.74	$3,820.00	$634.52	**$8,788.22**

AIChE ACCOUNT	Starting	Income	Expenses	Balance
Dues Income - Divisions (01/2015)		$ 390.00		$ 5,168.91
Dues Income - Divisions (02/2015)		$ 300.00		$ 5,468.91
sponsor check - Univ of Pitt (02/2015)		$ 660.00		$ 6,128.91
Dues Income - Divisions (03/2015)		$ 360.00		$ 6,488.91
sponsor check - DOW Chemical (03/2015)		$ 660.00		$ 7,148.91
Promotion-email (03/2015)			$ 21.32	$ 7,127.59
Dues Income - Divisions (04/2015)		$ 270.00		$ 7,397.59
Promotion-email (04/2015)			$ 10.63	$ 7,386.96
Dues Income - Divisions (05/2015)		$ 135.00		$ 7,521.96
Promotion-email (05/2015)			$ 11.86	$ 7,510.10
Dues Income - Divisions (06/2015)		$ 30.00		$ 7,540.10
Dues Income - Divisions (07/2015)		$ 75.00		$ 7,615.10
Registration income - Special Events (07/2015)		$ 340.00		$ 7,955.10
Dues Income - Divisions (08/2015)		$ 585.00		$ 8,540.10
Registration income - Special Events (08/2015)		$ 1,190.00		$ 9,730.10
Contributions - Corporate (08/2015)?		$ 1,320.00		$ 11,050.10
Totals as of 08/2015	$ 4,778.91	$ 6,315.00	$ 43.81	**$ 11,050.10**

University of Pittsburgh

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

Particle Technology Forum Organization

PTF EXECUTIVE COMMITTEE (ACADEMIC)

- Dr. Benjamin Glasser
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- Dr. Jim Gilchrist
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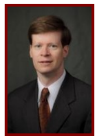

- Dr. Raj Dave
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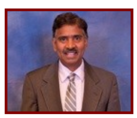

- Dr. Ben Freireich
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- Dr. Bruce Hook
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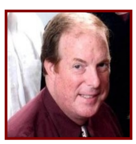

- Dr. Mehrdad Kheiripour
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@merck.com

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PTF NEWSLETTER
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Dr. Ray Cocco
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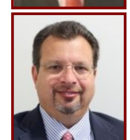

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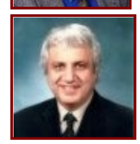


All past PTF newsletters are now archived at the PTF site on the Newsletter section under the menu heading "Activities".

http://aicheptf.org/activities/newsletter.
Please email any comments, suggestions, or concerns regarding the web site to Pat Spicer
p.spicer@unsw.edu.au

CTOC Liaison: Dr.Ray Cocco

SIOC Liaison: Dr. Reza Mostofi

Student Workshop Chair: Dr. Mayank Kashyap

Education Committee: Dr. Shrikant Dhodapkar

WCPT8 Chair: Dr. Ray Cocco

AIChE Staff Liaison: Ms. Darlene Schuster

Particle Technology Forum Organization

PROGRAMMING LEADERSHIP

GROUP 3A: PARTICLE PRODUCTION AND CHARACTERIZATION

Chair: Dr. Raj Dave
(dave@njit.edu)

Vice Chair: Dr. Stephen Conway
(Stephen_conway@merck.com)

GROUP 3B: FLUIDIZATION & FLUID-PARTICLE SYSTEMS

Chair: Dr. Reddy Karri
(reddy.karri@psri.org)

Vice Chair: Dr. Marc Olivier-Coppens
(m.coppens@ucl.ac.uk)

GROUP 3C: SOLIDS FLOW, HANDLING AND PROCESSING

Chair: Dr. Ben Freireich
(bjfreireich@dow.com)

Vice Chair: Dr. Clive Davies
(C.Davies@massey.ac.nz)

GROUP 3D: NANOPARTICLES

Chair: Dr. Karsten Wegner
(wegner@ptl.mavt.ethz.edu)

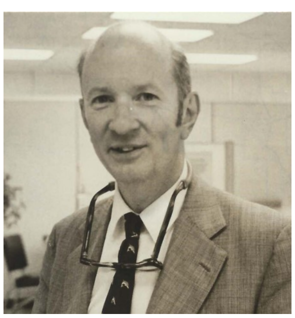
Vice Chair: Dr. Steven Saunders
(steven.r.saunders@wsu.edu)

GROUP 3E: ENERGETICS

Chair: Dr. Lori Groven
(Lori.Groven@sdsmt.edu)

Vice Chair: Dr. Edward L. Dreizin
(dreizin@njit.edu)

HISTORY OF PARTICLE TECHNOLOGY



Dr. Fred Zenz worked at Hydrocarbon Research Inc. and the M.W. Kellogg Company from 1946 until 1956. While working for these companies he obtained valuable experience in fluidized beds, entrainment, cyclone design, standpipe flow, pneumatic conveying and distributor design. He was one of the top engineers involved in developing the new Fluidized Cracking Catalyst process at M.W. Kellogg. In 1956, M.W. Kellogg asked Fred to go to Houston, but he did not want to leave the New York area and declined. This turned out to be bad for M.W. Kellogg, but very good for the Particle Technology Community.

After he declined to leave New York, Fred wrote the pioneering book “Fluidization and Fluid-Particle Systems” and began his iconic consulting in the field of fluidization. The book was the required “bible” for nearly every engineer working in the particle technology field during the 60’s, 70’s and 80’s. Fred became an Independent Consultant in the fluid-particle field in 1962, and for the next 4 decades was a legendary figure in the field, writing papers containing his knowledge about how to design cyclones, fluidized beds, etc. and also about how to scale up fluidized systems. Fred founded Particulate Solid Research, Inc. (PSRI) in 1969, and Analogies in Matters of Science (AIMS) in 1989. He also taught in the Chemical Engineering Department in Manhattan College starting in 1986. With his research, educational papers about fluid-particle systems and his pioneering book, Fred Zenz made a huge contribution to the Particle Technology field.

Ted Knowlton