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.

My special thanks to Reza Mostofi for his active participation in the Editorial Advisory Committee. He has been an extraordinarily productive and effective PTF Chair, and we thank him for his service to our community.

Shrikant Dhodapkar, Newsletter Editor
Dow Chemical Company

In this issue…

2016 AIChE Annual Meeting

November 13-18, 2016
San Francisco, CA

Particle Technology Forum Dinner

Date: November 16, 2016 (Wednesday)

Time: 6:30 pm—10 pm

Location: The Rotunda by Neiman Marcus

Address: 150 Stockton St, San Francisco, CA 94108

Dinner Ticket: $85

Sponsors of the PTF Dinner

JENIKE & JOHANSON
Bulk Solids: Science/Engineering/Design

COMPUTATIONAL PARTICLE FLUID DYNAMICS

Letter from The Chair

Welcome to the last edition of the PTF newsletter of the year which is also my last chance to communicate with you as the chair. This gives me a chance to quickly review what we have done during the past few years. Here are the highlights:

- Revamp newsletter in many ways -
  - ⇒ Advertisement
  - ⇒ Editorial Advisory Board
  - ⇒ Technical articles
  - ⇒ Profiles in Excellence
- Student poster competition revisit
- Establish the service award procedure
- Create a new award for young professionals
- Revise, Combine and standardize all awards criteria
- Review bylaws and propose amendments
- Use AIChE email and voting system

One important subject that I was hoping to achieve during my service was to increase our membership. We might have a change in our membership, but I feel that we need to put together a comprehensive program to increase and also diversify our members. Another aspect that we have made some progress but could try harder is to understand the needs of our industrial and also international members better. My final unfinished task is to establish a program to recruit new leaders for PTF. I hope to be able to work on these in future as the past chair if the new EC feels they are valuable for PTF business.

As you know we had our EC election just recently and the new EC members will join our EC meetings and officially start serving from January 2017. I want to thank the EC members whose term ended this year. Prof. Marc-Olivier Coppens and Dr. Mehrdad Kheiripour have served from January 2013 and helped in different aspects of PTF business.

The bylaws amendments will be voted on at our annual meeting is San Francisco. I hope you had a chance to review the changes and vote “YES”. This changes will help us to achieve our common goals and also clarify some of the parts that were subject to interpretation.

A big thank you to all the EC members and all the area and session chairs and co-chairs who have dedicated may hours to make PTF stronger and better year after year. It was an honor for me to work with all of you.

Lastly, I would like to echo Dr. Ralph Nelson’s advice, as I truly believe this volunteer work is rewarding in many ways:
"Do not be shy about accepting an opportunity to serve in a leadership position. The work is real, but so is the personal and professional growth you will acquire. Accept the challenge!"

Reza Mostofi

UOP, A Honeywell Co.

PTF Award Winners 2016

Elsevier PTF Lifetime Achievement Award

Professor Darsh Wasan is the University Distinguished Professor, Motorola Chair in Chemical Engineering and Vice President for International Affairs at Illinois Institute of Technology (IIT). He received his B.S. degree from the University of Illinois at Urbana-Champaign and his Ph.D. from the University of California at Berkeley. He has spent his entire professional career at IIT, and has held a variety of academic and administrative posts, including chemical engineering department chairman, interim dean of engineering, vice president for research and technology, and vice president for academic affairs and provost. He has supervised over 100 graduate students including 62 Ph.D. students and 15 Postdoctoral Fellows. He has over 400 publications, and is co-author of a textbook on "Interfacial Transport Processes and Rheology." He is a member of the U.S. National Academy of Engineering. His many other honors include the American Institute of Chemical Engineers Alpha Chi Sigma Award for Chemical Engineering Research, the Thomas Baron Award of PTF, the American Chemical Society National Award in Colloid and Surface Chemistry and the Excellence in Teaching Awards from both IIT and the American Society for Engineering Education. He served as editor-in-chief of the Journal of Colloid and Interface Science (1993-2014).

Award Talk

Nanofluids-fluid/particle interaction forces and novel applications

2:10 PM Wednesday, November 16, 2016
Golden Gate (Hotel Nikko San Francisco)

Shell Thomas Baron Award in Fluid-Particle Systems

Professor Rodney Fox received his PhD in Chemical Engineering, Kansas State University in 1987. He joined Iowa State University as the Glenn Murphy Professor of Engineering in 1999, and was the Herbert L. Stiles Professor of Chemical Engineering from 2003-2012. Since 2001, he has been Associate Scientist at the US-DOE Ames Laboratory. He was promoted to Distinguished Professor in Engineering in 2010. Prior to joining ISU, Fox was an Associate Professor of Engineering at Kansas State University, and has held visiting professorships in Denmark, France, Italy, Switzerland and the Netherlands. His numerous professional awards include a NSF Presidential Young Investigator Award in 1992 and the ISU Outstanding Achievement in Research Award in 2007. Professor Fox was elected Fellow of the American Physical Society in 2007. From 2012-14, he was a Marie-Curie Senior Fellow at the Ecole Centrale in Paris, France. In 2015 he was selected as an International Francqui Professor by the Francqui Foundation in Belgium, and awarded a Chaire d'Attractivité at the Université Fédérale Toulouse Midi-Pyrénées, France. In 2016 he was selected for the North American Mixing Forum Award for Excellence and Sustained Contributions to Mixing Science and Practice.

Award Talk

Quadrature-based moment methods for fluid-particle flows

1:20 PM Wednesday, November 16, 2016
Golden Gate (Hotel Nikko San Francisco)

PTF Award Winners 2016

PSRI Lectureship in Fluidization Award

Prof. Benjamin J. Glasser, of Rutgers University, received his BS and MS in Chemical Engineering from University of the Witwatersrand, Johannesburg, South Africa and his PhD, also in Chemical Engineering, from Princeton University. He has made pioneering contributions to our understanding of instabilities in fluidized beds, and fluid-particle and granular flows. His research has examined the hierarchy of instabilities in normal, inverse and sheared fluidized beds, why some beds bubble while others do not, and what minimum physics must be included to capture these instabilities in simulations. His work has recognized that the dynamics of dense fluid-particle flows are heavily influenced by granular rheology and his research on granular flow instabilities in several different contexts has added to our understanding of the evolution of complex structures in fluid-particle flows. His research has also sought to probe and develop applications involving use of fluidized beds. It includes experiments on fluidized bed adsorption of pharmaceutical proteins by resin particles and development of a fluidized bed process for impregnation of a drug substance into a highly porous excipient and subsequent drying, which leads to elimination of several unit operations for pharmaceutical production.

Award Talk

The Dynamics of Normal, Inverse and Sheared Fluidized Beds - Theory and Applications

12:30 PM Wednesday, November 16, 2016
Golden Gate (Hotel Nikko San Francisco)

ANSYS Particle Technology Forum Service Award

Dr. Ray Cocco has been with PSRI for eight years where he has the role of President and CEO. PSRI is a consortium-based company with 35 member companies headquartered in Canada, France, Brazil, Finland, Germany, India, South Africa, Saudi Arabia and the United States. Before PSRI, Ray spend 17 years with The Dow Chemical Company where he led research and development efforts in numerous particle technology platforms including the production of WoodStalk™ (a particleboard made of straw) for Dow BioProducts, the production of vinyl chloride monomer and RCl oxidation using fluidized beds, the production of hydrocarbon using circulating fluidized beds, the development of polyolefin catalyst for fluidized beds, and in the production of aluminum nitride and silicon carbide ceramic powders using moving bed reactors. In addition, Dr. Cocco was instrumental in bring in computational fluid dynamics, Six Sigma and Design for Six Sigma methodologies into Dow 's research environment. He has 50 publications, three book chapters, several patents, numerous of invited presentations and consults for industry, national labs and universities on a regular basis.

ANSYS®

Sponsor of PTF Service Award

PTF Award Winners 2016

George Klinzing Best PhD Award

Dr. Maxx Capece graduated with a B.S. and Ph.D. in chemical engineering from the New Jersey Institute of Technology. His dissertation entitled, "Multi-Scale Modeling of Dry Milling Processes: Influence of Mechanical Multi-Particle Interactions" was awarded in 2014 under the advisement of Dr. Rajesh Davé and Dr. Ecevit Bilgili. His dissertation focuses on understanding and modeling the complex particle breakage behavior exhibited in size-reduction processes. Maxx also has contributions in the area of polymer coating and is co-inventor on the patent, "Solventless Mixing Process for Coating of Pharmaceutical Ingredients" which recently won the 2016 Thomas Alva Edison Patent Award from the New Jersey R&D Council. The patent details a process to taste-mask and control the dissolution of pharmaceutical ingredients without the use of solvents. Maxx currently works for the biopharmaceutical company, AbbVie, at the North Chicago, IL R&D site as a Sr. Scientist in Formulation Sciences. His research at AbbVie focuses on the modeling of unit operations and the improvement of oral solid dosage formulation through the use of in silico modeling. Maxx has already published over 15 journal papers and continues to publish and present at major conferences in the area of particle technology.

SABIC Young Professional Award

Dr. Alexandra Teleki is a Senior Scientist and Head of Formulation Laboratory at DSM Nutritional Products, Switzerland focusing on novel encapsulation processes for the formulation of nutraceuticals with final applications in human nutrition. She received her MSc in Chemical Engineering from KTH Stockholm, Sweden (2003), her PhD from ETH Zurich, Switzerland (2008) and carried out postdoctoral research at ETH Zurich (2008-10) before joining DSM. She has published 28 papers in leading scientific journals and holds 11 patent applications. Her research in particle technology, especially on the development of a one-step synthesis and nanothin coating of flame-made particles, has been recognized by both academia and industry with several awards including the DSM Science & Technology Award (2009) and the ETH medal for outstanding PhD (2008). She is currently an editorial board member of the Powder Technology journal and a Lecturer at ETH Zurich where she teaches classes in nanoscale engineering.

History of Particle Technology

Evolution of Particle Technology in Germany

Prof. Dr.-Ing. Arno Kwade, Institut für Partikeltechnik, TU Braunschweig

Dr.-Ing. Harald Wilms, Zeppelin Systems GmbH, Friedrichshafen

German particle technology research, as we know today, started in the former West Germany primarily with the work of Professor Hans Rumpf in Karlsruhe, who is considered as the father of modern Particle Technology in Germany. After his PhD at the University of Karlsruhe in 1939 on the subject of classification of particles in spiral airflows and holding different industrial positions at IG Farben (today BASF), Alpine and Bayer, he become the professor and chair of the newly founded institute for mechanical process engineering in 1957. His research group included engineers, physicists, chemists and mathematicians. Nineteen of his students eventually became professors at various prestigious university and continued to develop his ideas and concepts to relate microscale properties to design processes on macroscale. Professor Hans Rumpf passed away in 1976 at the age of 65 leaving a rich legacy of academic and industrial research. Well known "scientific sons" of Prof. Rumpf are listed in the following table.

These well connected and highly networked researchers, who knew each other from their time at Karlsruhe, clearly dominated and defined the German Particle Technology Research for years to come. Many of them have since retired or passed away (Friedrich Löffler, Klaus Schönert and Kurt Leschonski), however, they themselves have generations of students who have continued to be the leaders in particle technology research.

Name	Institution	Major Research Topics
Fritz Ebert	University of Kaiserslautern	particle flow, particle separation
Bernd Koglin	Universities of Karlsruhe & Köln	sedimentation, particle dispersions
Kurt Leschonski	TU Clausthal	particle size measurement & classification
Friedrich Löffler	Karlsruhe Institute of Technology	particle separation & aerosol technology
Otto Molerus	University of Erlangen	powder mechanics & two-phase flow
Manfred Pahl	University of Paderborn	mixing of solids and fluids, foams
Klaus Schönert	TU Clausthal	comminution
Helmar Schubert	University of Karlsruhe	food processing, especially granulation
Jörg Schwedes	TU Braunschweig	bulk solids handling & wet grinding
Karl Sommer	TU München	mixing, granulation & particle transport
Reiner Weichert	TU Clausthal	particle separation, comminution

Similar to West Germany, a group in East Germany around Heinrich Schubert - coming from the mineral processing field - started at the Bergakademie Freiberg research in the field of Particle Technology, especially in the areas of comminution, separation and bulk solids handling. One very successful student of Heinrich Schubert was Prof. Jürgen Tomas, who worked in the field of bulk solids handling and microparticle mechanics.

Key scientific objective of both these schools (West and East German) was the better understanding and the simulation of important unit operations in the fields of separation/classification, comminution, mixing and granulation as well as of the more general topics of bulk solids handling and particle characterization. After the German reunification in

1989, new chairs and institutes were formed or revitalized. In addition to Freiberg in East Germany, at Magdeburg Jürgen Tomas and Lothar Mörl took over as the chairs for the Mechanical Process Engineering and for Equipment and Environment Technology departments respectively. In 1992, under the guidance of Jörg Schwedes, they jointly managed to start a "priority program" financed by the German Research Foundation (DFG). In this priority program on "Production, Classification, Separation and Measurement of fine particles (sizes below 10 µm)" about 25 projects of the different particle technology research groups in Germany along with some groups from adjacent fields, such as ceramics, were executed. In this program a strong interaction between the different University groups was further deepened, and it is still thriving.

After the first wave of Prof. Rump's students, a new generation of professors have now taken over the institutes and chairs at the different universities. Wolfgang Peukert, who got his PhD under the guidance of Friedrich Löffler at Karlsruhe, and took over the chair for process engineering at Munich in 1998. Later, in 2003, he moved to Erlangen where he is currently the chair for solids and interface process technology. He has championed the German particle technology research on the product development, especially on the particle-particle-interactions along with detailed investigation of varous unit operations. In Karlsruhe, Gerhard Kasper continued the work of Friedrich Löffler on aerosol technology and dry particle separation, while Hermann Nirschl expanded the work of Werner Stahl on solids-liquid-separation to mixing, dispersing and particle synthesis with a strong focus on the simulation of this processes. Arno Kwade, who is the successor of Jörg Schwedes at Braunschweig, continues the focus on bulk solids handling at particulate level and included organic materials like API in comminution processes. His research interests include formulation of materials for energy storage in batteries and pharmaceutical products; as well as the related process simulation and optimization. At Magdeburg university, Jürgen Tomas and Lothar Mörl, Thomas Gröger and Andre Katterfeld have focused on Discrete Element Modeling (DEM) of solids handling. In Hamburg, Stefan Heinrich became successor of Joachim Werther and focuses on fluidized bed processes, especially for the design of complex products, and DEM- and flow sheet simulations for particle processes. Today at Freiberg Urs Peuker runs the Institute of Mechanical Process and Mining Technology with the focus on separation processes and composite particle design. The chair of Particle Process Engineering in Paderborn is held by Hans-Joachim Schmid, who focuses on rheology, aerosols, additive manufacturing and complex disperse systems. In Kaiserslautern, Sergij Antonyuk recently took over as the chair for Mechanical Process Engineering from Siegfried Ripperger.

Based on his forward-looking ideas, Wolfgang Peukert managed to apply and achieve a Cluster of Excellence on "Engineering of Advanced Materials" from the German Research Foundation, in which hierarchical structure formation for functional devices is investigated including the production of the functional materials. At the beginning of the 21st century, the product-minded research became the focus of the future research than the continued research on unit operations. However, the group of Particle Technology professors in charge today work intensively on both research objectives, i.e. on one hand deep understanding of unit operations including their simulation, among others by using new measurement methods, and on the other hand product design based on deep knowledge on mechanisms on micro scale. The focus on product design also implies the consideration of entire process chains (sequence of unit operations) and the interaction between the different

process steps.

For a very long time, as most of the researchers in process and chemical engineering were engineers, the German Particle Technology community was organized in different expert committees of the society of Process and Chemical Engineering (GVC) within the Association of German Engineers (VDI). In contrast, the colleagues working in the fields of Biochemical Engineering, Biotechnology and Technical Chemistry were organized in committees of the Society for Chemical Technology and Biotechnology (DECHEMA). However, in 2007 the network "ProcessNet", an initiative of GVC/VDI and DECHEMA, was founded to bring the experts of the two societies together. Today, the experts are organized in different sections of ProcessNet. One of the nine sections is the section "Particle Technology and Product Design". It focuses on "methods for the production, processing, formulation and characterization of multiphase products, whose structure is often complex, with a highly specific, characteristic profile tailored to the individual application. The product properties define the application area, from classical fields of process engineering in the chemical industry increasingly diverging into the fields of electronics, energy technology, life sciences, nanotechnology, optical technologies, materials and environmental technology". The description of the section underlines the importance of product design for the today´s Particle Technology Research in Germany. The section is organized in 10 subject divisions primarily according to the different unit operations and not to the different product groups: Agglomeration and Bulk Solids Technology, Comminution and Classification, Crystallization, Drying, Food Technology, Interface-dominated Systems and Processes, Mechanical/Liquid Separation, Multiphase Flow, Particle Measurement and Rheology. Usually two to four different subject divisions have joint yearly meetings to support exchange between the different disciplines.

Based on the first two priority programs in the 90s, some new priority programs in the field of Particle Technology have been launched since 2007 which exemplify the recent focus of research in this area:

Objective of the priority program "Colloid Process Technology", started in 2007 and guided by Matthias Kind from Karlsruhe, who is an expert in particle synthesis by precipitation and crystallization, was the investigation of the entire process chain to produce colloid suspensions, i.e. submicron particle synthesis, particle dispersing and conditioning as well as suspension formulation.

In 2010 a priority program on particles interactions, called "particle in contact", was launched based on intensive discussions during yearly meetings of the German Particle Technology Professors, which was originally chaired by Jürgen Tomas and now by Sergiy Antonyuk from University of Kaiserslautern. In this priority program the contact forces between particles were investigated on micro-scale with newly developed measurement methods. Thus, new contact models for DEM simulations were derived. Moreover, the effect of the contact force on the bulk was determined by means of DEM simulations and macro-scale measurements.

In 2013, initiated by Stefan Heinrich (TU Hamburg-Harburg) and Arno Kwade (TU Braunschweig) a new priority program named "DynSim" on the dynamic simulation of processes with particles started. Objective of this program is to develop enhanced process models for detailed flowsheet simulation of process chains (unit operations) in which particles are processed to different products. In this program also multi-scale models are used to determine the detailed effect of the process parameters on the distributed particle properties.

This year, the priority program "DiSPBiotech" was set up in which the changes of proteins (single proteins

or protein clusters) and biological cells in dispersity, structure and phase along the entire process chain are investigated. Although the topic belongs more to biochemical engineering, this priority program was initiated by the German Particle Technology community in order to start an interdisciplinary research with biochemical engineering: On one hand modern methods of Particle Technology shall be used to characterize the behavior of biological products, i.e. bacteria or other cells, on the other hand the formulation of the proteins to create stable products is of special interest to particle technologists.

Next year (2017), a program on the fractionating of particles in the size range smaller 10 µm will be initiated. This priority program, guided by Urs Peuker from TU Freiberg, aims to develop new separation methods and methods to manipulate particles for a better separation effect .

Research on particle technology certainly is dominated by university research. However, also industry-related activities shall not be forgotten. The DLR (German Aerospace Center) in Cologne is driving research in the field of bulk solids properties under very low stresses – as encountered on comets and planetoids. The German Association of Cement Factories (VDZ) has for many years supported research activities in bulk solids handling and comminution. The Ceramic Research Division of the Fraunhofer Gesellschaft (FhG) ran research projects on bulk solids technology and powder sintering.

Strong industrial support for the powder technology field starting in the chemical industry. Chemical industry giants, such as BAYER AG, ran their own particle process technology labs and supported suppliers with solids handling data and expertise. Later, engineering companies provided respective development capabilities, for instance Lurgi for fluidized bed technology. Equipment manufactures, such as Alpine (later Hosokawa, Augsburg), Schenck Process (Darmstadt), and Zeppelin (Friedrichshafen), used the methods developed in powder mechanics for reliable design of milling, drying and sifting equipment, feeders, silos, blenders and pneumatic conveying systems. Today, application technology expertise is provided by consulting companies like Schwedes+Schulze. Dietmar Schulze has made outstanding contributions to the field with his development and commercialization of the Ring Shear Tester. This tester has now become the defacto industry standard for powder flowability testing. All these industry experts are active members of ProcessNet, thus facilitating a joint university-industry network. German industry also initiates and co-sponsors research programs at universities through research grants provided by AiF, the German Federation of Industrial Research Associations.

Today, a considerable amount of research is shifted to European level asking for Europe-wide cooperation. One of the earliest initiatives has been the joint work on shear testing within the European Federation of Chemical Engineers (EFCE-WPMPS) and the Community Bureau of References (BCR) for certification of powder flow properties – both being supported by German universities and industries. More recently, the European ParDEM and T-MAPPP-projects were supported and executed by several German companies and universities. Respective international collaboration is expected to intensify in the future.

In summary, the foundation of modern particle technology research in Germany was laid down by Hans Rumpf and his students during the last century. Their primary focus was development of understanding of the particle-level interactions and the unit operations. The 21st century brought forth a new emphasis of “product design” by tailoring, manipulating and engineering properties at micro-scale. However, research on unit operations like separation, comminution, classification,

mixing and granulation is still considered as important as the research on functional products like advanced particulate materials (e.g.3D-printing), food / pharmaceutical products, energy storage systems (e.g. lithium-ion-batteries), and structured chemical products like catalysts.

All the fundamental research in particle technology is supported by industrial activities which aims to transfer research results into technology and products. The strength of our research community in Germany and the strong role of our companies is the result of premium educational offerings in this field at numerous universities. Certainly, as new frontiers continue to evolve, we believe that the field of particle technology will maintain its role as the driving force in the German research community and the industry.

Have New Ideas for PTF Newsletter ?

Shrikant Dhodapkar sdhodapkar@dow.com

Editorial Advisory Committee

Ray Cocco, Reza Mostofi,
Raj Dave, Pat Spicer

PTF Website

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

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PTF Election Results

VICE-CHAIR

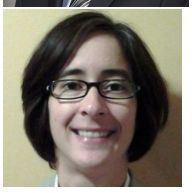
- Dr. Bruce Hook
BDHook@dow.com

NEW PTF EXECUTIVE COMMITTEE MEMBERS

- Dr. Ah-Hyung Alissa Park
ap2622@columbia.edu

- Dr. Richard Lupetow
r-lueptow@northwestern.edu

- Dr. Mayank Kashyap
mkashyap@americas.sabic.com



- Dr. Brenda Remy
brenda.remy@bms.com

Tutorial For Young Professionals

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

George Klinzing, Shrikant Dhodapkar, Ray Cocco

Sunday, November 13, 2016
3:30 PM - 6:00 PM
Golden Gate—Hotel Nikko
Covers various topics of interest to the Young Professionals

The World of Particle Technology

AIChE Particle Technology Forum Student Workshop

Presenters:

S.B. Reddy Karri (PSRI)

Ben Freireich (The Dow Chemical Company)

Mayank Kashyap (SABIC) – Chair

As part of the mission of AIChE PTF, we have been proudly serving the particle technology community by introducing the field to students, young engineers and scientists, and raising awareness about its importance and relevance to the modern Chemical Process Industry. Continuing the tradition of organizing workshops for students at the *AIChE Annual Student Conferences* over the years, PTF will be bringing the world of particle technology into the lives of future engineers and scientists once again this year in San Francisco.

The hugely successful workshops provided by PTF in the past few years had witnessed over 500 students and professors in attendance on each occasion. We expect to raise the bar even higher this year with a greater response from participants. We encourage undergraduate and graduate students to participate in the following fun-filled and educational session that will include exciting presentations and live demonstrations from some of the well-renowned researchers in the field of particle technology.

Part I: More than 80% of your gasoline, 70% of your polyolefins and a plethora of other products are made using fluidized bed technology. From gasification to drying, fluidized beds and circulating fluidized beds provide the distinct advantage of high heat transfer and solids mobility. These features have resulted in several breakthrough technologies with better temperature control and the ability to move solids from a reduction to an oxidation environment. This workshop will focus on some of these breakthrough technologies.

Part II: Billions of pounds of bulk solids are processed and handled every year by the US process industries, yet most chemical engineers are ill-equipped to deal with the complexities of the engineering science of solids processing/particle technology. Hence, plants and products suffer with lost production, inability to achieve design production rates, off grade or off specification products, etc. During this session, we will take a look at the fun and exciting (and often counterintuitive!) world of solids processing. Specifically, we will look at some of the more common particle-based technologies examining both the important role they play in society today along with the associated technical challenges.

Demonstration of Particle Technology in Action: If a picture is worth a thousand words, then a video is worth a thousand pictures and a live demonstration is worth a thousand videos. This session will also illustrate some of the awe-inspiring and unique features in the field of particle technology through hands-on demonstrations on fluidization, hopper design, segregation, etc.

The featured demonstration unit this year will include a mini-circulating fluidized bed (CFB) prototype comprising a riser, standpipe, and cyclone. The cold-flow mini-CFB is capable of fluidizing particles classified as Geldart groups A, B, C and D in various fluidization regimes, such as bubbling, turbulent, transport regimes, etc.

The World of Particle Technology

2016 AIChE Annual Student Conference

Saturday, November 12, 2016

12:30 PM – 1:20 PM

Continental 4, Hilton - Union Square

Investigating The Blend Homogeneity Inside A Bin Blender Using Discrete Element Method

Maitraye Sen[a,1,2], Subhodh K. Karkala[a,1], Savitha S. Panikar[a], Olav Lyngberg[b], Mark C. Johnson[b], Alexander Marchut[b], Elisabeth Schafer[b], Rohit Ramachandran[a,*]

[a]Department of Chemical and Biochemical Engineering, Rutgers, the State University of New Jersey
[b]The Janssen Pharmaceutical Companies of Johnson & Johnson

Introduction

Powder mixing is an important unit operation in pharmaceutical industries and maintaining blend uniformity is critical since it dictates the quality of the final tablet. Granular materials are often mixed using tumbling bin blenders in these industries as they are safe and convenient to handle [1]. Discrete element method (DEM) is often used to simulate powder flow as it treats the particles as discrete entities and is able to the track interactions of individual particles as they move through a system. It has been used widely to study different kinds of batch and continuous blenders with different mixing mechanisms for both free flowing and cohesive particles. For example, extensive studies have been previously conducted on the mixing dynamics of the V-blender [2], conical blender [3] and Chaudhuri et al. studied the mixing of cohesive particles in a tumbling blender [4]. Detailed analysis of the mixing mechanisms in bin blenders have also been conducted [5][6]. In the present work, a DEM model for a bin blender has been used to study the effect of sampling location on blend variability prediction.

In the actual setup, a near-infrared (NIR) probe mounted on the lid of a blender is used to measure the composition of the blend every time the blender is in an inverted position. These readings only consider the region of particles near the lid and it is unclear if they could predict the relative standard deviation (RSD) of the composition i.e. the variability in the entire blend. Since obtaining data about the bulk mixture during the blending operation experimentally is challenging, a DEM model is used to get a sense of how well the measurements made near the lid of the blender are able to predict the content uniformity of the entire blend.

Model Development

The blender modeled here is an industrial scale bin blender (800 liter volume) consisting of a cylindrical top and a conical bottom as shown in Figure 1. The ratio of height of the blender to the diameter of the cylindrical base is 1.45:1. To create a geometry for the DEM model, a 3D computer aided drawing of the bin blender was built to scale using SOLIDWORKS® (Dassault Systémes). The blending process involved the mixing of two active pharmaceutical ingredients (API) namely API 1 and API 2 with an excipient called extra granular phase. The name of the materials and the exact dimensions of the geometry are withheld for proprietary reasons. These materials were added into the blender in the following order: half of API 2 was loaded first, followed by the entire mass of API 1, followed by the entire mass of the extra granular phase and the remaining half of API 2 was added at the end. The blender was rotated about a horizontal axis (as shown in Figure 1) at a speed of 6 rpm and the simulation was run for 50 revolutions. The Hertz-Mindlin model was used to simulate the physics of the particle-particle and particle-wall interactions.

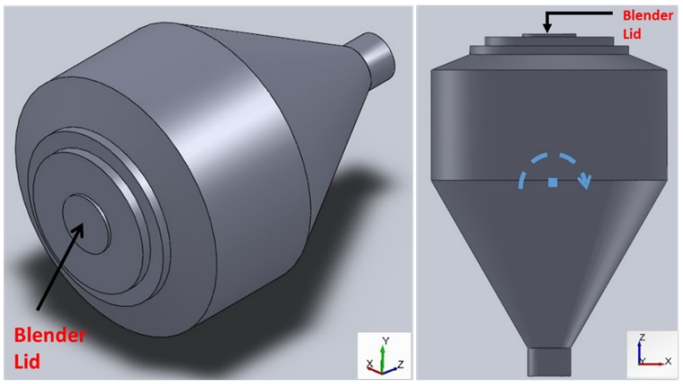


Figure 1: Pictorial representation of the bin blender showing lid and axis of rotation

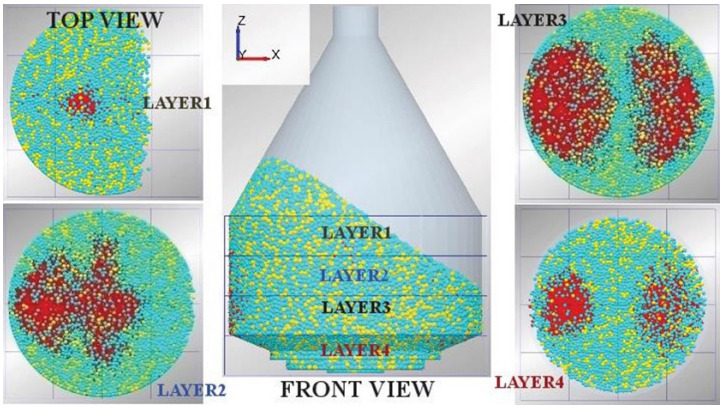


Figure 2: Discretization of the blender into different zones (sub-sections)

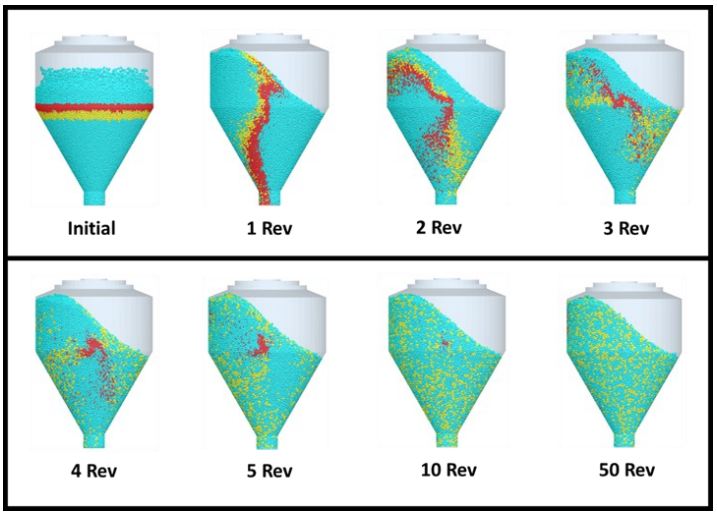


Figure 3: State of the blending process across different revolutions. API1, API2 and extra granular phase are represented by yellow, blue and red particles respectively.

The DEM model was created using EDEM® (DEM Solutions). The materials used in the blending process were simulated as spherical particles in the model. These particles were also scaled up from their actual sizes in order to reduce computational time but the actual particle size ratios were maintained during scale up. The shear modulus and Poisson's ratio for the particles were adjusted such that the overlap between the particles did not exceed 15% at any point in the simulation. The coefficient of static and rolling friction parameters in DEM influence how particles flow through the system. These parameters were calibrated individually for each material type based on the angle of repose study by Zhou et al [7]. The coefficient of restitution was kept at a low value of 0.01 as powder particles undergo inelastic collisions [8]. The complete set of parameters used in the simulation is presented in Table 1 and Table 2.

To aid in the analysis of the simulation results, the cylindrical section of the blender was divided into 4 layers each having 16 sub-sections as shown in Figure 2. Composition data were collected from each of these sections when the blender was in an inverted position and then used to calculated the relative standard deviation (RSD) of the composition for each material type according to equation 1. Here, x_{avg} is the overall average fractional composition, x_i is the fractional composition at the i^{th} bin and M is the total number of bins. In other words, M is the total number of samples collected from the model for performing the RSD calculations

$$RSD_i = \frac{\sqrt{\frac{\sum_{i=1}^{i=M}(x_{avg}-x_i)^2}{M-1}}}{x_{avg}} \quad (1)$$

It can be seen from the Figure 2 that there are very few particles present in some of the sub sections. Therefore, these bins have been excluded from the RSD calculation. An RSD was calculated considering all four layers called the overall RSD. Another RSD was calculated using only the composition data from the sub-sections in 4th layer (bottom layer) which was simply termed as layer 4 RSD.

This represents the variation of blend homogeneity

Table 1: Material properties used in DEM simulations

Material type	Density (kg/m^3)	Particle diameter (mm)	Shear Modulus (Pa)	Poisson's Ratio
API 1	715.9	21.21	2.0E6	0.33
API 1	731.6	20.26	2.0E6	0.33
Extra granular phase	672.0	9.02	2.0E6	0.33
Steel	8000.0	-	7.9E10	0.33

Table 2: Particle-particle(P-P) and Particle-Wall (P-W) interaction parameters used in DEM simulations

Material type	Coefficient of static friction		Coefficient of rolling friction	
	P-P	P-W	P-P	P-W
API 1	0.50	0.40	0.10	0.08
API 1	0.50	0.40	0.05	0.08
Extra granular phase	0.95	0.90	0.10	0.05

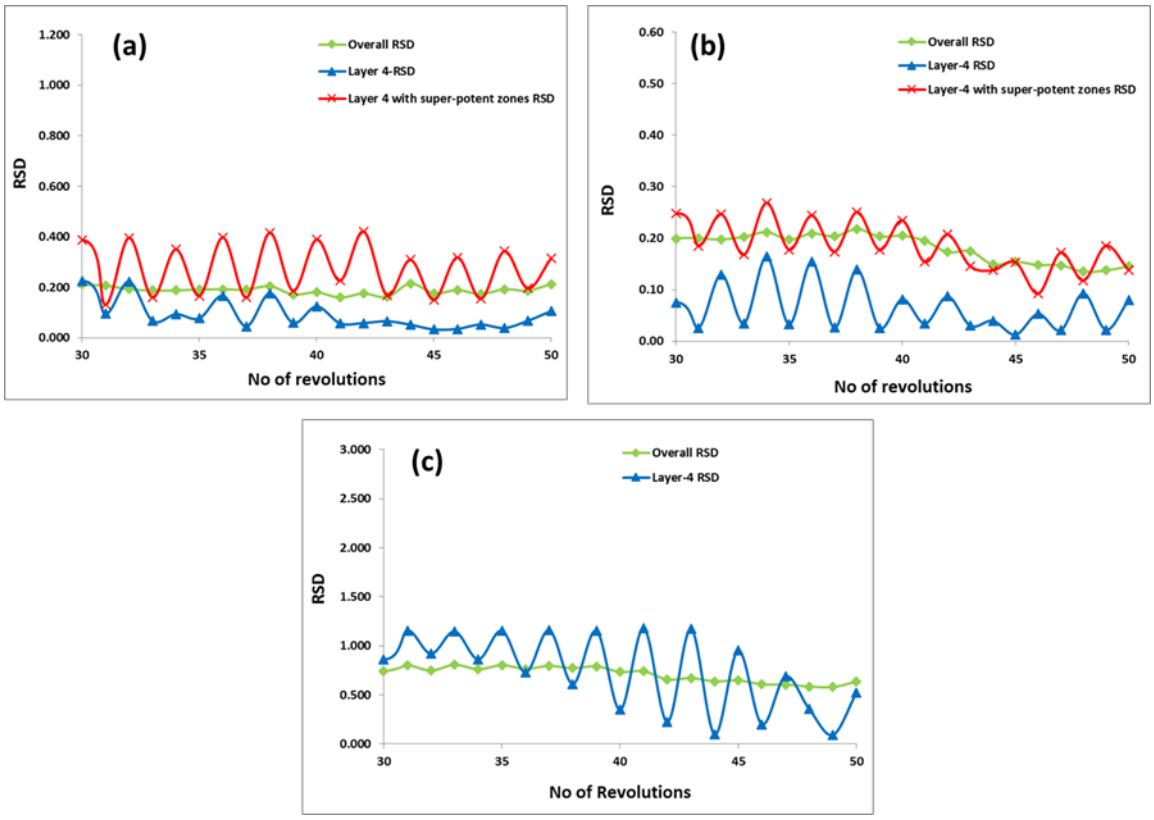


Figure 4: Comparison of the different RSDs for: (a) API 1, (b) API 2 and (a) Extra granular phase

in the blender lid region.

Results

The blending process was carried out until 50 revolutions and Figure 3 shows the state of particles inside the blender across different revolutions. Figure 4 compares the variation of overall RSD values with the layer 4 RSD over different revolutions of the blender. It can be seen that the composition data obtained from the layer 4, is under-estimating the overall variability of API 1 and API 2 in the mixture but is able to give a good estimate the overall variability of the extra granular phase in the mixture.

In order to get a better prediction of the RSDs of API 1 and API 2, the model was further used to investigate other potential sampling points. Super-potent and sub-potent regions of API 1 and API 2 were identified and are shown in Figure 5. Among those regions, the ones that were close to the blender walls were used as additional sampling points. It was found that including the measurements from the super-potent regions along with the measurements from layer 4 resulted in better predication of the RSDs of materials API 1 and API 2 as shown in Figure 4 (a) and (b). It can be seen from the plots that the new RSD for API 1 is not under-estimated when compared to the overall mixture RSD while the new RSD for API 2 is reasonably close to the overall RSD.

The effect of process parameters namely fill level and blender rotation on blending process were also studied using the model. Two levels of each parameter were considered and this resulted in 4 cases of simulations:

Case 1: Blender RPM= 6 and Fill level= 65% (which is the base case)

Case 2: Blender RPM= 6 and Fill level= 40%

Case 3: Blender RPM= 12 and Fill level= 65%

Case 4: Blender RPM= 12 and Fill level= 40%

API 1 is the material of interest and hence its RSD variations over number of revolutions for these four cases are plotted in figure 6. We can observe that the RSD decreases with reduction in the fill level and increase in the blender RPM. RSD decreases over the number of revolution for case 2 and case 3

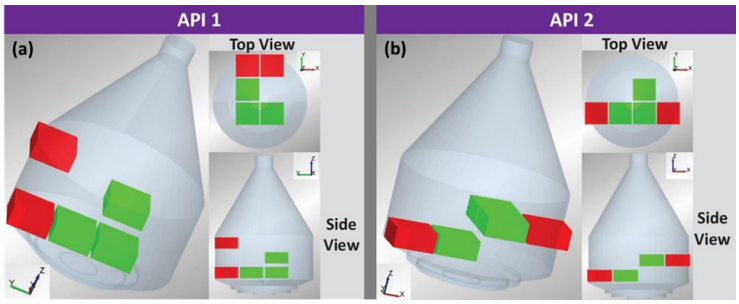


Figure 5: Super-potent and sub-potent regions in the mixing of (a) API 1 and (b) API 2

when compared to the base case.

However, for case 4, the RSD is the least (among all the four cases) until the 12th revolution, after which the RSD starts increasing and approaches a value close to the base case by the end of the simulation. One explanation for this observation is that due to a high RPM and low fill volume, the ingredients are mixed comparatively faster (i.e., by 12 revolutions) and mixing beyond 12 revolutions is causing segregation. Therefore, mixing time is also an important factor to be considered in case of a batch mixing

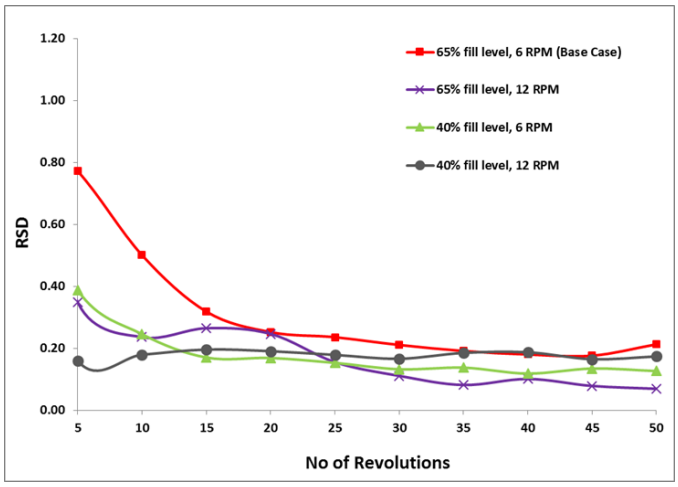


Figure 6: Variation of RSD of API 1 with change in fill level and blender RPM

operation.

Conclusions

A DEM model was developed for an industrial batch bin blender. This model was used to simulate the mixing behavior of three materials and to investigate if the composition data from the lid region could be used to predict the overall variability in the blend. It was found that measurements made near

the lid region were insufficient to make an accurate conclusion about the RSD for materials API 1 and API 2. Additional sampling sites were identified and it was found that including the composition data from super potent regions along with the data from layer 4 gave better prediction of the RSDs for API 1 and API 2. A study of the effect of fill level and blender rotation on blending process revealed that while RSD decreased with reduction in the fill level and increase in the blender RPM, mixing time was also an important parameter for the model to prevent segregation of the blend.

References:

[1] P. E. Arratia, N. Duong, F. J. Muzzioa, P. Godbole, S. Reynolds, A study of the mixing and segregation mechanisms in the bohle tote blender via DEM simulations, Powder Technology 164 (2006) 50-57.

[2] P. Tahvildarian, F. Ein-Mozaffari, S. R. Upreti, Circulation intensity and axial dispersion of non-cohesive solid particles in a V-blender via DEM simulation, Particuology 11 (2013) 619-626.

[3] M. Alian, F. Ein-Mozaffari, S. R. Upreti, J. Wu, Using discrete element method to analyze the mixing of the solid particles in a slant cone mixer, Chemical Engineering Research and Design 93 (2015) 318-329.

[5] A. Mehrotra, F. J. Muzzio, Comparing mixing performance of uniaxial and biaxial bin blenders, Powder Technology 196 (2009) 1-7.

[6] P. E. Arratia, N. Duong, F. J. Muzzioa, P. Godbole, A. Lange, S. Reynolds, Characterizing mixing and lubrication in the bohle bin blender, Powder Technology 161 (2006) 202-208.

[7] Y. C. Zhou, B. H. Xu, A. B. Yu, P. Zulli, An experimental and numerical study of the angle of repose of coarse spheres, Powder Technology 125 (2002) 45-54.

[8] A. Dubey, A. Sarkar, M. Ierapetritou, C. R. Wassgren, F. J. Muzzio, Computational approaches for studying the granular dynamics of continuous blending processes, 1-DEM based methods, Macromolecular Materials and Engineering 296 (2011) 290-307.

Elected AIChE Fellow

Professor Marc-Olivier Coppens is the Ramsay Memorial Professor and Head of Department of Chemical Engineering at University College London (UCL). He is also the founding Director of the Centre for Nature Inspired Engineering at UCL, funded by one of only five EPSRC "Frontier Engineering" Awards in the UK, and involving numerous industrial and academic collaborations. Marc-Olivier was elected Fellow of the AIChE for demonstrating extraordinarily high professional accomplishment and service to the profession. His professional accomplishments are noteworthy as a scholar, educator, research center creator and director, and academic administrator. His work on nature-inspired chemical engineering, including in particle technology, has made him internationally recognized and respected as an expert in process intensification and innovation. His volunteer professional service has also been outstanding, including bedrock and high-level leadership roles within AIChE.

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.

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

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PTF Membership Committee

Profiles in Excellence

Dr Rachel Smith

Lecturer in Chemical Engineering, Department of Chemical and Biological Engineering

The University of Sheffield, Sheffield, UK

Dr. Satish K.. Nune

Senior Research Scientist

Applied Functional Materials, Pacific Northwest National Laboratory (PNNL), Richland, WA

Dr Rachel Smith has been a lecturer in the Department of Chemical and Biological Engineering at the University of Sheffield since 2012. Rachel's primary research interests relate to particle-particle and particle-fluid interactions, with the aim to relate micro-scale phenomena to process performance and product function and develop useful design tools for industrial applications. Rachel's research uses a range of experimental techniques and computational methods (DEM, PBM) to tackle particle processing problems across several industries, including pharmaceuticals, foods, and consumer products. In her time at Sheffield, her research group has grown to include post-doc Dr Kate Pitt, and 8 PhD students as primary supervisor, with several more as second and co-supervisor. She has active research projects in a wide range of particle technology areas, spanning powder and particle coating, computational modelling of the breakage mechanisms in high shear wet granulation, mechanistic model development for non-wetting powders, model development for granule consolidation and layering, fluidised bed drying and granulation, and spherical agglomeration.

Rachel currently holds a Royal Society Research Fellowship, which along with a funding from the EPSRC has enabled her to work closely with Procter and Gamble to study particle coating in tumbling drums. In particular, this work is focussed on investigating the contact spreading mechanism between particles, and on developing tools to predict this mechanism of liquid distribution. She is a committee member of the IChemE Particle Technology Special Interest Group, and an active member of the Particle Technology Forum.

To tackle the increasing energy challenges, Dr. Satish K. Nune has developed various hybrid nanostructured materials with engineered porosity (framework type materials, porous doped-carbons, iron rich carbon-based nanorods etc.). His research encompasses synthesis and processing of nanoscale porous materials, their functionalized analogues with varied hydrophobicity by taking advantage of metal-ligand cooperation effect for sustainable, economical and energetically favored chemical transformations. He uses unconventional approaches to further synthesize and functionalize porous nanomaterials with well-defined active sites and activity that cannot be synthesized otherwise. In a major breakthrough, recently, he along with his colleagues at PNNL has developed iron rich carbon-based nanorods that exhibited a unique water adsorption phenomenon that offers promise for superior water management in engineered systems. The rods adsorb water at low humidity and spontaneously expel about half the adsorbed water at high relative humidity (RH), believed to be first-of-a-kind material and opened-up a new class of materials for liquid adsorption and expulsion.

Dr. Nune's work on green nano-manufacturing of gold nanoparticles in aqueous conditions has also received considerable attention worldwide.

Satish is an active member within the Particle Technology Forum and Nanoscale Science & Engineering Forum community and was also an adjunct teaching faculty at Washington State University (WSU-TriCities) during 2010-2012. He has organized and co-organized multiple sessions at American Chemical Society's (ACS-ENFL) division and at American Institute of Chemical Engineers (AICHE). He has over 52 publications, 1 book chapter and 12 patents (3 US patents issued, 5 Japan; 4 US patents filed) to his credit. His research work is highly regarded with numerous citations (>1700) from research groups worldwide and has *h*-index 21.

Obituary

Prof. Dr.-Ing. habil. Jürgen Tomas, left us on November 24, 2015 at the age of 62. We have lost an outstanding researcher, university teacher, and for many of us also a true and good friend. Our sympathy goes to his wife and family.

He was born in 1953 in Zerbst. Prof. Tomas studied process engineering (process systems engineering) at the Institute of Technology (TH) Merseburg (1971 -1975). From 1975 until 1992 he was research assistant at the Department of Mechanical Process Engineering and Mineral Processing of the Institute of Mining Technology (Bergakademie) Freiberg, where he earned his PhD degree in 1982. Until 1987 he was also a consultant for designing silo plants in process industries and until 1989 he was also teaching as Assistant Professor at Addis Abeba University (Ethiopia). In 1991, he earned his habilitation and in 1994 he received a full professorship as Chair of Mechanical Process Engineering at the Faculty of Process and Systems Engineering, Otto-von-Guericke-University Magdeburg, Germany. From 1995-1996 and 2001-2002 he was also Head of the Department of Process Engineering. In 2006 he became full member of the Saxon Academy of Science of Leipzig, and from 2006 to 2012 he was the Dean of the Faculty of Process and Systems Engineering of the University Magdeburg. Since 2009, he was coordinator of the Priority Programme 1486 “Particles in Contact - Micromechanics Microprocess Dynamics and Particle Collectives” of the German Research Foundation (DFG). In 2012, he was Deputy Secretary of the Class of Engineering Sciences of the Saxon Academy of Science, and in the same year he became a member of editorial board of Journal of Powder Technology.

His scientific and research interest focused on particles and their interaction, especially as far as the contact behaviour was concerned. He successfully modelled time consolidation of soluble minerals and supported research work in an industrial scale relating to the discharge behaviour of cohesive solids from silos. The impact of vibrations on the flowability was another of his topics. He also investigated the formulation of nanoparticles and the breaking behaviour of agglomerates and, last not least, promoted application-focused research in DEM modelling and simulation. Thus, he has covered the full range of topics in solids handling and particle technology – both in research and lecturing.

Throughout his academic career (37 years) he published more than 250 peer-reviewed papers, 380 conference papers were orally presented, of which more than 230 papers were presented in international conferences. Since 2005, he has chaired the working party “agglomeration and bulk solids technology” of the German society for process and chemical engineering - ProcessNet (Fachausschuss "Agglomerations und Schüttguttechnik" GVC/VDI). He has been full member of the Saxon Academy of Science of Leipzig, KDT, VDI-GVC, DECHEMA, the Working Group “comminution and classification”, the Working Group “mechanical solid-liquid separation”, and the ECCE Working Party on the Mechanics of Particulate Solids of European Federation of Chemical Engineering, where he started to collaborate very early, in 1979. He was also supervisor of more than 20 PhD students and numerous master and bachelor students.

Our memories, however, go beyond his outstanding academic career, his valuable contributions to our industry and his continuous enthusiasm to tackle new research topics. We recall many events, conferences and meetings where his personality contributed to the success of the events followed by some nice get-together-evenings. We remember him as a valuable friend.

We lose an excellent scientist and expert in the field of bulk solids mechanics and nanoparticle technology. We will always remember him with great respect.

Prof. Dr.-Ing. habil. Dr. h.c. Stefan Heinrich

Director of the Institute of Solids Process Engineering and Particle Technology of the Hamburg University of Technology

Chairman of the executive board of the German Working Party on Agglomeration and Bulk Solid Materials of VDI-ProcessNet

Board member of the Working Party on Agglomeration and of the Working Party on Mechanics of Particulate Solids of the EFCE

Dr.-Ing. Harald Wilms

Zeppelin Systems GmbH, Friedrichshafen

Honary Member of the Working Party on Mechanics of Particulate Solids of the EFCE

WCPT8 Update

8th World Congress on Particle Technology

The WCPT8 will be held in Orlando, Florida in the **April 22 through 26, 2018** in conjunction with the AIChE Spring Meeting at the Orlando World Center Marriott. Technical area to be represented are shown in the Table 1 (page 20).

We are currently looking for session chairs. If you are interested, please send your name, affiliation and email address to the chairs of the of the area you are interested in. It is going to be a great meeting so make sure you save the date.

Ray Cocco, PSRI

We are pleased to announce that **Merck** has provided a grant of $1,500 to support an Award for Research for the development of students. PTF EC has approved that this grant be used for the monetary award of the students’ poster award. Currently there is no official sponsor for the poster awards and as such starting from 2016, the students’ poster award will be known as Merck’s student posters award with a $500 cash prize for the winners.

Sponsor of
Student Poster Awards

MERCK

Table 1: Technical areas and area chairs for the 8th World Congress in Particle Technology

WCPT8 Technical Area	Chairs	Affiliation	Email Address
Particle and bulk powder characterization	Ben Freidreich	Dow Chemical	bjfreireich@dow.com
	Alvaro Ramirez Gomez	Universidad Politécnica de Madrid	alvaro.ramirez@upm.es
Particle interactions	Stefan Heinrich	TU Hamburg	stefan.heinrich@tuhh.de
	S. Matsusaka	University of Kyoto	mats@cheme.kyoto-u.ac.jp
Particle design	Mark Jones	University of Newcastle	mark.jones@newcastle.edu.au
	Yongsheng Han	Chinese Academy of Sciences	yshan@ipe.ac.au
Handling and processing of granular materials	David Craig	Jenike and Johanson	dacraig@jenike.com
	Shrikant Dhodapkar	Dow Chemical	sdhodapkar@dow.com
Particle surface functionalization	Alan Weimer	University of Colorado at Boulder	alan.weimer@colorado.edu
	Younjune Park	GIST	young@gist.ac.kr
Particle classification	Junwu Wang	Chinese Academy of Sciences	junwuwang@sina.com
	Benjamin Amblard	IFPEN	benjamin.amblard@ifpen.fr
Fluidization and multiphase flow	S.B. Reddy Karri	PSRI	reddy.karri@psri.org
	Xiaotao Bi	University of British Columbia	tony.bi@ubc.ca
Sustainable energy and environmental applications	Eric Shen	ExxonMobil	eric.b.shen@exxonmobil.com
	Alissa Park	University of Columbia	ap2622@columbia.edu
Particulate systems for separation applications	Fanxing Li	North Carolina State University	fli5@ncsu.edu
	Allan Issangya	PSRI	allan.issangya@psri.org
Particle technology for pharmaceutical applications	Chi-Hwa Wang	National University of Singapore	chewch@nus.edu.sg
	Brenda Remy	Bristal Meyers Squibb	brenda.remy@bms.com
Solids processing unit operations	Haim Kalman	Ben Gurion University of the Negev	hkalman@bgu.ac.il
	Peter Wypych	University of Wollongong	wypych@uow.edu.au
Special topics in particle technology	Madhuysudahan Kodam	Dow Chemical	mkodam@dow.com
	Paola Lettieri	University College London	p.lettieri@ucl.ac.uk
Education in particle technology	Maynak Kashyap	SABIC	mkashyap@americas.sabic.com
	George Klinzing	University of Pittsburg	klinzing@pitt.edu

8th World Congress on Particle Technology

Expanding Boundaries

April 22 - 26, 2018 ● Orlando World Center Marriott ● Orlando, FL

Save the Date!

The 8th World Congress on Particle Technology (WCPT8) will be held in conjunction with the 2018 AIChE Spring Meeting & 14th Global Congress on Process Safety.

On behalf of AIChE and the Particle Technology Forum (PTF), we invite you to participate, learn, teach and collaborate.

The WCPT8 conference will focus on all aspects of particle technology from fundamental research to applied successes in areas including:

- Particle Processing Technologies
- Particulate Product Engineering
- Specialty Particle Research
- Characterization & Measurement Techniques for Particles & Particulate Systems
- Modeling & Simulation of Particle Hydrodynamics & Interactions

The Call for Abstracts for the WCPT8 will open in the Spring of 2017.

For more information on programming areas, important dates, and the organizing committee, visit:
www.aiche.org/wcpt8

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Annual Meeting - San Francisco 2016

Business Meetings:

Meeting	Date / Time	Location
Particle Technology Forum Executive Committee Meeting	Sunday, November 13, 2016: 6:00 PM-7:30 PM	Parc 55 San Francisco Mission II
Particle Technology Forum Area 3A Meeting	Wednesday, November 16, 2016: 5:50 PM-6:30 PM	Hotel Nikko San Francisco Bay View
Particle Technology Forum Area 3B Meeting	Wednesday, November 16, 2016: 5:50 PM-6:30 PM	Hotel Nikko San Francisco Peninsula
Particle Technology Forum Area 3C Meeting	Wednesday, November 16, 2016: 5:50 PM-6:30 PM	Hotel Nikko San Francisco Monterey II
Particle Technology Forum Area 3D Meeting	Wednesday, November 16, 2016: 5:50 PM-6:30 PM	Hotel Nikko San Francisco Golden Gate
Particle Technology Forum Area 3E Meeting	Wednesday, November 16, 2016: 5:50 PM-6:30 PM	Hotel Nikko San Francisco Carmel II

2016 Annual Meeting - PTF Sessions

Sunday, November 13

Late PM

24 Circulating Fluidized Beds and Measurement Techniques in Fluid-Particle Systems
3:30 PM-6:00 PM, Nikko: Bay View

44 Particle Engineering As Applied to Pharmaceutical Formulations
3:30 PM-6:00 PM, Nikko: Peninsula

50 Solids Handling and Processing in the Chemical Industry: What They Don't Teach You at School
3:30 PM-6:00 PM, Nikko: Golden Gate

Monday, November 14

Morning

61 Agglomeration and Granulation Processes I
8:00 AM-10:30 AM, Nikko: Bay View

77 Dynamics and Modeling of Particulate Systems I
8:00 AM-10:30 AM, Nikko: Peninsula

85 Fundamentals of Fluidization I
8:00 AM-10:30 AM, Nikko: Golden Gate

99 Nanostructured/Thin Film Photovoltaics
8:00 AM-10:30 AM, Hilton: Golden Gate 5

101 Plenary Session: Complex Particle Flows
8:00 AM-10:30 AM, Parc 55: Market Street

Early PM

130 Agglomeration and Granulation Processes II
12:30 PM-3:00 PM, Nikko: Bay View

144 Dynamics and Modeling of Particulate Systems II
12:30 PM-3:00 PM, Nikko: Peninsula

149 Fundamentals of Fluidization II
12:30 PM-3:00 PM, Nikko: Golden Gate

Late PM

197 Applications of Engineered Structured Particulates
3:15 PM-5:45 PM, Nikko: Bay View

206 Characterization and Measurement in Powder Processing
3:15 PM-5:45 PM, Nikko: Peninsula

215 Fundamentals of Fluidization III
3:15 PM-5:45 PM, Nikko: Golden Gate

223 Nanoelectronic and Photonic Materials
3:15 PM-5:45 PM, Hilton: Golden Gate 5

225 Particle Surface Effects in Solids Handling
3:15 PM-5:45 PM, Nikko: Monterey II

2016 Annual Meeting - PTF Sessions

Tuesday, November 15

Morning

270 AIChE-SCEJ Joint Session: To Celebrate Prof. Masayuki Horio's Career Long Accomplishments
8:30 AM-11:00 AM, Nikko: Golden Gate

285 Control and Optimization of Particle and Solids Production
8:30 AM-11:00 AM, Nikko: Bay View

286 Crystallization Process Development I
8:30 AM-11:00 AM, Parc 55: Cyril Magnin III

302 Mixing and Segregation of Particulates I
8:30 AM-11:00 AM, Nikko: Peninsula

Early PM

344 Crystallization Process Development II
12:30 PM-3:00 PM, Parc 55: Cyril Magnin III

368 Mixing and Segregation of Particulates II
12:30 PM-3:00 PM, Nikko: Bay View

371 Novel Nanoparticles and Nanostructured Materials for Energy and Environmental Applications I
12:30 PM-3:00 PM, Nikko: Peninsula

378 Special Session: To Celebrate Prof. Sankaran Sundaresan's Career Long Accomplishments
12:30 PM-3:00 PM, Nikko: Golden Gate

Late PM

408 Fluidization and Fluid-Particle Systems for Energy and Environmental Applications I
3:15 PM-5:45 PM, Nikko: Peninsula

421 Novel Nanoparticles and Nanostructured Materials for Energy and Environmental Applications II
3:15 PM-5:45 PM, Nikko: Golden Gate

422 Particle Breakage and Comminution Processes
3:15 PM-5:45 PM, Nikko: Bay View

448 Poster Session: Particle Technology Forum
6:00 PM-8:00 PM, Hilton: Grand Ballroom B

Wednesday, November 16

Morning

470 Energetic and Reactive Materials I
8:30 AM-11:00 AM, Nikko: Bay View

473 Fluidization and Fluid-Particle Systems for Energy and Environmental Applications II
8:30 AM-11:00 AM, Nikko: Peninsula

474 Functional Nanoparticles
8:30 AM-11:00 AM, Nikko: Golden Gate

2016 Annual Meeting - PTF Sessions

Early PM

526 Energetic and Reactive Materials II
12:30 PM-3:00 PM, Nikko: Bay View
543 Nanomaterials Synthesis and Self-Assembly Strategies
12:30 PM-3:00 PM, Hilton: Golden Gate 5
547 Novel Nanoparticles and Nanostructured Materials for Catalysis - Influence of Particle Size
12:30 PM-3:00 PM, Nikko: Peninsula
549 Particle Technology Awards Lectures
12:30 PM-3:00 PM, Nikko: Golden Gate

Late PM

581 Dynamics and Modeling of Particles, Crystals and Agglomerate Formation
3:15 PM-5:45 PM, Nikko: Peninsula
583 Engineered and Amorphous Particle Formation Technologies
3:15 PM-5:45 PM, Parc 55: Cyril Magnin I
601 Novel Nanoparticles and Nanostructured Materials for Catalysis - Support Interactions
3:15 PM-5:45 PM, Nikko: Golden Gate
612 Thermophysics and Reactions in Energetic Materials
3:15 PM-5:45 PM, Nikko: Bay View

Thursday, November 17

Morning

620 Active Colloidal Systems
8:30 AM-11:00 AM, Hilton: Union Square 23 & 24
640 Fundamentals of Nanoparticle Coatings and Nanocoatings on Particles
8:30 AM-11:00 AM, Nikko: Peninsula
654 Novel Nanoparticles and Nanostructured Materials for Catalysis - Control in Synthesis and Application
8:30 AM-11:00 AM, Hilton: Franciscan A
656 Particle Formation and Crystallization Processes from Liquids, Slurries, and Emulsions
8:30 AM-11:00 AM, Parc 55: Cyril Magnin I
658 Population Balance Modeling for Particle Formation Processes: Nucleation, Aggregation, and Breakage Kernels
8:30 AM-11:00 AM, Nikko: Bay View
667 Topics in Solids Drying
8:30 AM-11:00 AM, Nikko: Golden Gate

Early PM

691 Industrial Application of Computational and Numerical Approaches to Particle Flow I
12:30 PM-3:00 PM, Nikko: Golden Gate
701 Novel Nanoparticles and Nanostructured Materials for Pharmaceuticals and Medical Applications
12:30 PM-3:00 PM, Nikko: Bay View
714 Solids Handling and Processing I: Powder Flow
12:30 PM-3:00 PM, Nikko: Peninsula

2016 Annual Meeting - PTF Sessions

Late PM

726 Characterization of Engineered Particles and Nanostructured Particulate Systems
3:15 PM-5:45 PM, Nikko: Peninsula
736 Industrial Application of Computational and Numerical Approaches to Particle Flow II
3:15 PM-5:45 PM, Nikko: Golden Gate
749 Solids Handling and Processing II
3:15 PM-5:45 PM, Nikko: Bay View

Friday, November 18

Morning

766 Particle Engineering As Applied to Pharmaceutical Formulations II
8:30 AM-11:00 AM, Hilton: Continental 5

Early PM

774 Amorphous Solid Dispersions for Drug Product
12:30 PM-3:00 PM, Hilton: Continental 4

Special Sessions

Tuesday, November 15

Session 270

AIChE-SCEJ Joint Session: To Celebrate Prof. Masayuki Horio's Career Long Accomplishments

8:30 AM-11:00 AM, Nikko: Golden Gate

Session 378

Special Session: To Celebrate Prof. Sankaran Sundaresan's Career Long Accomplishments

12:30 PM-3:00 PM, Nikko: Golden Gate

Wednesday, November 16

Session 549

Particle Technology Forum Award Lectures

12:30 PM-3:00 PM, Nikko: Golden Gate

Treasurer's Report

NY ACCOUNT	Starting	Income	Expenses	Balance
sponsor check from Elsevier (10/09/2015)		$1,340.00		$10,128.22
sponsor check from Jenike (10/29/2015)		$2,000.00		$12,128.22
sponsor check from CPFD Software, LLC for banquet wine (10/29/2015)		$2,000.00		$14,128.22
sponsor check from PSRI (10/29/2015)		$1,170.00		$15,298.22
banquet payment in addition to $4,142 (prepayment) (11/13/2015)			$4,032.06	$11,266.16
IN picture-it award (12/02/2015)			$412.80	$10,853.36
Merck poster award check (12/21/2015)			$200.00	$10,653.36
Merck poster award check (01/05/2016)			$300.00	$10,353.36
IN picture-it award (02/08/2016)			$319.90	$10,033.46
U of Pitt (02/17/2016)		$670.00		$10,703.46
service charge			$5.50	$10,697.96
check given to Ben to create a new account (04/04/2016)			$500.00	$10,197.96
EIG*BLUEDOMINO (04/04/2016)			$155.40	$10,042.56
check given to Ben to create a new account (05/16/2016)			$6,000.00	$4,042.56
EIG*BLUEDOMINO (06/02/2016)			$107.40	$3,935.16
monthly fee (06/30/2016)			$18.00	$3,917.16
monthly fee (07/29/2016)			$18.00	$3,899.16
Totals as of 09/2016	$8,788.22	$7,180.00	$12,069.06	**$3,899.16**

NJ ACCOUNT	Starting	Income	Expenses	Balance
deposit from NY account (04/04/2016)		$500.00		$500.00
deposit from NY account (05/16/2016)		$6,000.00		$6,500.00
Totals as of 09/2016	$0.00	$6,500.00	$0.00	**$6,500.00**

Revenue generated from advertisements in the PTF Newsletter in 2015:

Organization	Description	Cost
Coperion K-Tron	A half page advertisement in Summer Edition	$250.00
Kansas State University	A half page advertisement in Summer Edition	$250.00
Coperion K-Tron	A half page advertisement in Fall Edition	$250.00
University of Delaware	A full page advertisement in Fall Edition	$500.00
		Total: $1250.00

Treasurer's Report

AIChE ACCOUNT	Starting	Income	Expenses	Balance
Dues Income - Divisions (09/2015)		$ 735.00		$ 10,465.10
Registration Income - Special Events (09/2015)		$ 5,440.00		$ 15,905.10
check to FINCA (deposit for the PTF banquet 11/2015)			$ 4,142.00	$ 11,763.10
Dues Income - Divisions (10/2015)		$ 450.00		$ 12,213.10
Registration income - Special Events (10/2015)		$ 2,040.00		$ 14,253.10
Corp sponsorship (MERCK and Shell) (10/2015)		$ 4,280.00		$ 18,533.10
Monetary Awards (10/2015)			$ 5,000.00	$ 13,533.10
Dues Income - Divisions (11/2015)		$ 465.00		$ 13,998.10
Registration Income - Special Events (11/2015)		$ 765.00		$ 14,763.10
Corp sponsorship (Dow) (11/2015)		$ 660.00		$ 15,423.10
Delivery service (11/2015)			$ 20.45	$ 15,402.65
Promotion email (11/2015)			$ 14.53	$ 15,388.12
Dues Income - Divisions (12/2015)		$ 735.00		$ 16,123.12
Registration Income - Special Events (12/2015)		$ (85.00)		$ 16,038.12
Promotion email (12/2015)			$ 0.58	$ 16,037.54
Invest Inc - Interest (12/2015)		$ (593.39)		$ 15,444.15
Dues Income - Divisions (01/2016)		$ 480.00		$ 15,924.15
Dues Income - Divisions (02/2016)		$ 180.00		$ 16,104.15
Corp Sponsorship Inc (SABIC) (02/2016)		$ 1,170.00		$ 17,274.15
Dues Income - Divisions (03/2016)		$ 480.00		$ 17,754.15
Dues Income - Divisions (04/2016)		$ 360.00		$ 18,114.15
Promotion email (05/2016)			$ 59.85	$ 18,054.30
Dues Income - Divisions (05/2016)		$ 375.00		$ 18,429.30
Dues Income - Divisions (06/2016)		$ 30.00		$ 18,459.30
Promotion-email (06/2016)			$ 62.99	$ 18,396.31
Site Costs - Special Events (06/2016)			$ 5,000.00	$ 13,396.31
Dues Income - Divisions (07/2016)		$ 75.00		$ 13,471.31
Registration Income - Special Events (07/2016)		$ 1,190.00		$ 14,661.31
Totals as of 09/2016	$ 9,730.10	$ 19,231.61	$ 14,300.40	$ **14,661.31**

Particle Technology Forum Organization

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Have an idea for an article or suggestions for the PTF Newsletter or Website?

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