

American Institute of Chemical Engineers

Pharmaceutical Engineering for the 21st Century

Topical Conference at the
2007 AIChE Annual Meeting

November 4-9, 2007
Salt Lake City, Utah, USA

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571
www.proceedings.com

ISBN: 978-1-60423-844-0

Some format issues inherent in the e-media version may also appear in this print version.

ISBN: 978-1-60423-844-0

Copyright (2007) by the American Institute of Chemical Engineers.
All rights reserved.

For permission requests, please contact the American Institute of Chemical Engineers at the address below.

American Institute of Chemical Engineers
Proceedings
Three Park Avenue
New York, NY 10016-5991
Phone: 212-591-8100

www.aiche.org

TABLE OF CONTENTS

Combination of Experimental and Mathematical Techniques for Characterization of Particle Friability	1
<i>Pavol Rajniak, Rong Fan, Luke Schenck, Kumar Dhanasekharan, Rey Chern</i>	
Analysis of Aspirin Milling in Single Ball Mill	12
<i>R. Bertrum Diemer, Yulong Ding, Dolapo Olusanmi, Mojtaba Ghadiri, K. J. Roberts, Jon H. Olson</i>	
Optimization of Milling Using Attainable Region Theory	13
<i>Matthew J. Metzger, Benjamin Glasser, David Glasser, Brendon Hausberger, Diane Hildebrandt, Ngangezwe Khumalo</i>	
Numerical Simulation and Optimization of Grinding in Hammer Mill	14
<i>Bodhisattwa Chaudhuri</i>	
The Breakage Matrix Approach in Evaluating Inadvertent Breakage of Dense Particulate Mixtures	15
<i>A. Abu Nahar, U Tüzün</i>	
Effects of Co-Milling on Crystallinity of Salbutamol Sulphate Using Adipic Acid	16
<i>Prashant N. Balani, Wai Kiong Ng, Sui Yung Chan, Reginald B.H. Tan</i>	
Application of Box–Behnken Design and Response Surface Methodology for Modeling of Grinding Beach Sand Ore Using Ball Mill	20
<i>Asha Immanuel Raju Chaduvula, Murali Yugandhar Nikku, Kiran Kumar Nalla, Venkata Satya Chappidi, Srinivasa Babji Josyula, Israel Yedluri</i>	
The Quality by Design Approach to Pharmaceutical Development and Manufacturing	22
<i>Christine M.V. Moore</i>	
Challenges in Pharmaceutical Development and Manufacturing	23
<i>Kenneth R. Morris</i>	
Optimization Under Uncertainty for the Design and Planning of Process Systems	24
<i>Ignacio E. Grossmann</i>	
Role of PAT in Quality by Design	25
<i>Christine M.V. Moore</i>	
Process Analytical Technology for Crystallization Processes	26
<i>Richard D. Braatz</i>	
Measurement and Control of Product Attributes during Granulation: Challenges and Opportunities (No abstract)	27
<i>James D. Litster</i>	
Flow Structure Mapping of Segregating Granular Mixtures Using Radioactive Particle Tracking	28
<i>Jocelyn Doucet, Francois Bertrand, Jamal Chaouki</i>	
Mixing of Nanoparticles By Magnetically Assisted Impact Mixing Technique	29
<i>James V. Scicolone, Alexandre Ermoline, Ryan Barrow, Rajesh Dave</i>	
Segregation of Cohesive Particles During Hopper Discharge	30
<i>Anshu Anand, Jennifer S. Curtis, Carl R. Wassgren, Bruno C. Hancock</i>	
Eliminating Segregation In Free-Surface Flows of Particles	31
<i>Deliang Shi, Watson Vargas, Joseph J. McCarthy</i>	

Powder Flow Induced By Rough-Surface Moving Walls: Concentration Profile of a Binary Powder Mixture	32
<i>Luis Guillermo Obregon Quiñones, Carlos Velázquez Figueroa</i>	
Study of the Feedframe Effect on Particle Size Distribution	33
<i>Rafael Mendez-Roman, Fernando J. Muzzio, Carlos Velazquez</i>	
The Mechanism behind Axial Segregation of Granules in a Horizontal Rotating Drum	34
<i>Marleen M. H. D. Arntz, Wouter. K. Den Otter, Wim. J. Briels</i>	
Tower of Babel: Intelligent Data and Knowledge Management for Decision Support in Pharmaceutical Engineering	35
<i>Venkat Venkatasubramanian</i>	
Modeling and Numerical Simulation of Pharmaceutical Processes	36
<i>Hamid Arastoopour</i>	
Modelling Opportunities and Challenges in the Pharmaceutical Industry	37
<i>Christopher L. Burcham</i>	
Information Management: Challenges and Opportunities in Achieving Qbd (No abstract)	38
<i>Anjali Kataria</i>	
Thermodynamic Limits on Drug Loading in Nanoparticle Cores	39
<i>Varun Kumar, Robert K. Prud'homme</i>	
Alternating Copolymer Structures for Targeted In Vivo Imaging and Therapy In Cancer	46
<i>Michelle T. Miller, Kevin P. Brower, Jin Zhou, Robert J. Fisher, Mukesh K. Pandey, Rahul Tyagi, Arthur C. Watterson, Clark K. Colton</i>	
Implant Assisted Magnetic Drug Targeting: Ferromagnetic Nanoparticles for Enhancing the Retention of Magnetic Drug Carrier Particles	47
<i>Misael O. Aviles, Jan O. Mangual, Armin D. Ebner, James A. Ritter</i>	
Free Radical Scavenging By Cerium Oxide Nanoparticles: the Effect of Adsorbed Block Copolymers and Potential-Determining Ions	48
<i>Richey M. Davis, Will Miles</i>	
Drug-Delivery Nanoparticles Formed By Micellization of Polyethylene Glycol-Block-Polycaprolactone In Subcritical and Supercritical Solvents	49
<i>Zachary Tyrrell, Winoto Winoto, Maciej Radosz</i>	
Silica-Based Nanoparticles for Boron Neutron Capture Therapy	50
<i>Ilya Zharov</i>	
Prediction of Crystal Shape and Size Distributions Using Multidimensional Population Balances	51
<i>Christian Borchert, Nandkishor K. Nere, Andreas Voigt, K. Sundmacher, Doraiswami Ramkrishna</i>	
2-D Population Balance Modelling of Gibbsite Crystallization	53
<i>Andrey V. Bekker, Iztok Livk</i>	
Contin Analysis of Sals Data from Clusters of Particles beyond RDG Limit	63
<i>Marco Lattuada, Lyonel Ehrl, Miroslav Soos, Massimo Morbidelli</i>	
Molecular Dynamics Simulation of Diffusion of Fractal Aggregates	64
<i>Gaurav Pranami, R. Dennis Vigil, Monica Lamm</i>	
Modeling, Validation and Optimization of Antisolvent Crystallization: A New Approach In Predicting Solubility Using A Thermodynamic Model	65
<i>Ombretta Foddi, Ali Abbas, Massimiliano Grosso, Jose A. Romagnoli</i>	
Modeling the Sintering of Water Soluble Amorphous and Crystalline Particles	67
<i>Nicolas Descamps, Elsa Schreyer, Stefan Palzer</i>	

The Effects of Initial Polydispersity of Particle Size on the Growth Kinetics and Mechanism of Wet Granulation in a Laboratory-Scale High Shear Mixer by Means of Image Processing and Analysis	75
<i>Alvaro Realpe, Carlos Velazquez</i>	
Model Predictive Control of Continuous Drum Granulation of Limestone	83
<i>Thomas Glaser, Constantijn F. W. Sanders, Fu-Yang Wang, Ian T. Cameron, James D. Litster, Jonathan M. H. Poon, Rohit Ramachandran, Charles D. Immanuel, Francis J. Doyle III</i>	
Passive Acoustic Monitoring of High-Shear Wet Granulation	93
<i>Albert W. Alexander</i>	
Experimental Study of Wurster Granulation for Pharmaceutically-Relevant Excipient Blends	94
<i>Christopher Mancinelli, Pavol Rajniak, Frantisek Stepanek, Leon Farber, Brian Hill, Rey Chern</i>	
Suspension and Dispersion of Particles in Gels	95
<i>Micaela Caramellino, Piero M. Armenante</i>	
Opportunities, Challenges, and Approaches for Modeling In the Pharmaceutical Industry	96
<i>Prashant B. Kokitkar</i>	
Modeling of Breakage and Dissolution of Crystals with Varying Particle Size Distribution within the Quality by Design Framework	97
<i>Pavol Rajniak, Kim Gallagher, Rey Chern, Craig Ikeda, Justin Moser</i>	
Application of Modeling in a Qbd Context	102
<i>James Wertman</i>	
Coater-Dryer Models	103
<i>Alexander J. Marchut, Wei Chen, Steven H. Chan, Shih-Ying Chang, Olav Lyngberg, Donald Kientzler, San Kiang</i>	
Potential of S88, Batchml and Other Standards in Streamlining Process Modeling	104
<i>Alistair Gillanders</i>	
Batch Plus Modeling as a Tool To Drive R&d-Based Process Expansion	112
<i>Samrat Mukherjee, Shekhar Viswanath, Jeffrey Breting</i>	
Application of Agent Technique in Bioprocess Modelling for Plant-Wide Process Improvement	113
<i>Ying Gao, Katie Kipling, Jarka Glassey, Yuhong Zhou, Mark Willis, Gary Montague, Nigel Titchener-Hooker</i>	
An Integrated Quality by Design Qbd Approach for Pharmaceutical Powder Blending Unit Operation: Process Monitoring, Endpoint Determination, and Concentration Quantification	123
<i>Huiquan Wu, Mobin Tawakkul, Mansoor A. Khan</i>	
Quality By Design Using an Integrated Active Pharmaceutical Ingredient-Drug Product Approach To Development	138
<i>Mary T. am Ende, Vincent E. McCurdy, Thomas P. Garcia, Frank Busch, Mark R. Berry</i>	
The Use of Routine Process Capability In the Determination of Proven Acceptable Ranges (Pars) Critical Process Parameters (Cpps) and Mapping of the Design Space for an Api Process	139
<i>Kevin D. Seibert, Shanthy Sethuraman, Chad Wolfe</i>	
Mathematical Modeling of the Impact of Raw Material Variabilities On Granule Particle Size Distribution During Fluidized Bed Granulation	140
<i>Pavol Rajniak, Ecevit Bilgili, Rey Chern</i>	
Synchronized Approach to Developing Optimal Control and Design Spaces	142
<i>Jerry D. Mitchell, Bernard McGarvey, Kumar Abhinava, Kevin Seibert, Shanthy Sethuraman, Kristi Griffiths</i>	

Correlation between Excipient Characteristics and Product Properties through Numerical Simulations of Tablet Compaction	143
<i>Athanas A. Koynov, Alberto Cuitino</i>	
Characterizing the Influence of Raw Material and Process Variation on Product Quality and Yields	152
<i>Chris McCready</i>	
Dynamic Impact of Water Thermodynamics On Normal Phase Chromatography	153
<i>David Willcox</i>	
Application of In-Line Transmission Normal Phase Chromatography for Improved Process Understanding and Control of a Continuous Mixing Process	154
<i>Gregory M. Troup, John P. Higgins, Craig A. Mckelvey, Michael Lowinger, Jeff S. Ko, Luke R. Schenck, Robert F. Meyer, Brit L. Rudeen</i>	
Solid State Form Conversion Process	155
<i>Christopher L. Burcham, Jeffrey T. Vicenzi</i>	
Development and Implementation of a Drying Process for an Amorphous API Solid	156
<i>Yao-En (David) Li, Alex Coles, Gerrie Liaw, and Stephen Tyler</i>	
New Spectrophotometric Method for the Determination of Ambroxol Hydrochloride Using Artificial Neural Networks	157
<i>Asha Immanuel Raju Chaduvula, Kiran Babu Uppuluri</i>	
The Use of PAT in the Laboratory to Define and Optimize API Manufacturing Processes (No abstract)	158
<i>Mark A. LaPack</i>	
Batch Process End Point Using PCA and DCPA Model Based On FTIR and Calorimetry Data Measurements	159
<i>Shan Lin, Shekhar Viswanath, James Marek, Steve Richter, Zhi Wang, Clifford Mitchell</i>	
Numerical Bifurcation Analysis of Periodic Solution of Population Balance Models	160
<i>Mykhaylo Krasnyk, Michael Mangold, Achim Kienle</i>	
Modeling Soot Formation in Turbulent Flames by Direct Quadrature Method of Moments	168
<i>Federica Furcas, Alessandro Zucca, Daniele Marchisio, Antonello Barresi</i>	
A Mechanistic Model for Nucleation and Aggregation in Population Balances of Granulation: Batch Characterisation Studies and Experimental Validation	170
<i>Rohit Ramachandran, Jonathan M. -H.Poon, Constantijn F. W. Sanders, Thomas Glaser, Francis J. Doyle II, James D. Litster, Frantisek Stepanek, Fu-Yang Wang, I. T. Cameron, Charles D. Immanuel</i>	
Numerical Solution of Multi-Variable Cell Population Balance Models With A Free Boundary Algorithm	189
<i>Mihail E. Kavousanakis, Andreas G. Boudouvis, Nikos V. Mantzaris</i>	
Fast Monte Carlo Algorithms for Modeling and Optimization of Complex Particulate Processes	190
<i>Roberto Irizarry</i>	
A New Simulation Method for Population Balances Using Constant-Number Monte Carlo With Adjustable Time Step	200
<i>Samira Khalili, Antonios Armaou, Themis Matsoukas</i>	
Validation of Fcmom for Bi-Variate Population Balance Equations	201
<i>Matteo Strumendo, Hamid Arastoopour</i>	
Role of Counterion Replacement on the Deactivation of Co-Salen Catalysts in the Hydrolytic Kinetic Resolution of Epichlorohydrin	202
<i>Surbhi Jain, Xiaolai Zheng, Christopher W. Jones, Marcus Weck, Robert J. Davis</i>	

Experimental and Dft Study of Base- and Ligand-Free Pd/c-Catalyzed Homocoupling Reactions of Arylboronic Acids	203
<i>Jeng-Shiou Chen, Johannes Khinast</i>	
Development of New Covalently Tethered Group 4 Metallocenes	204
<i>Heidrun Woelfler, Georg Schitter, Rafael Eder, Claire Jeanquartier, Johannes G. Khinast</i>	
The Discovery of an Innovative and Very Green One-Step Synthesis of Tetronic Acid	205
<i>Josef G. Schroer</i>	
Triflation Reaction Endpoint By A T R - F T I R, P L S - Based Chemometrics Model	206
<i>James Marek, Shan Lin, Shekhar Viswanath, Clifford Mitchell</i>	
Multi-Step Hydrogenations and Process Understanding for Api Manufacturing (No Abstract)	207
<i>Jason Mustakis, David J. Am Ende</i>	
Effect of Different Vessel Geometries on the Hydrodynamics of Partially Baffled Stirred Tank Reactor Systems Equipped with a Retreat Blade Impeller	208
<i>Giuseppe Di Benedetto, Piero M. Armenante, Billy R. Allen</i>	
Continuous Powder Blending for Pharmaceutical Applications	209
<i>Michael Gentzler, Ecevit Bilgili, Brit L. Rudeen, Mano Ramasamy, Steve J. Heidel</i>	
Model Predictive Control on Roller Compaction for Pharmaceutical Manufacturing	210
<i>Shuo-Huan Hsu, Girish Joglekar, Gintaras V. Reklaitis, Venkat Venkatasubramanian</i>	
Experimental Study and Computational Modeling of Continuous Powder Mixing Processes	212
<i>Patricia M. Portillo, Marianthi G. Ierapetritou, Fernando J. Muzzio</i>	
Determination of Granulation Growth Rates: an Evaluation Between FBRM and Sieve Analysis	214
<i>Kevin Macias, M. Teresa Carvajal</i>	
Effect of Stirrer Design on the Homogeneity of a Pharmaceutical Powder Mixture	215
<i>Henri Berthiaux, Cendrine Gatamel, Jean-Louis Dirion</i>	
Application of In-Line Transmission Nir for Improved Process Understanding and Control of a Continuous Mixing Process	223
<i>Gregory M. Troup, John P. Higgins, Craig A. Mckelvey, Michael Lowinger, Jeff S. Ko, Luke R. Schenck, Robert F. Meyer, Brit L. Rudeen</i>	
Continuous Blending of Powders: Effect of Process Variables and Material Properties	224
<i>Lakshman Pernenkil, Farzad J. Yazdi, Jason Whittaker, Charles Cooney</i>	
Crystals and Crystallization Processes: A Crystallographic Perspective	232
<i>Qi Gao, William L. Parker</i>	
Relationship Between Self-Association of Molecules In Supersaturated Solutions and Solid State Outcome	233
<i>Deniz Erdemir, Soma Chattopadhyay, Liang Guo, Jan Ilavsky, Heinz Amenitsch, Carlo U. Segre, Allan S. Myerson</i>	
Selective Crystallization of the Metastable Anhydrate Form in the Enantiotropic Pseudo-Dimorph System of L-Phenylalanine Using Feedback Concentration Control	234
<i>Nicholas Kee, Paul D. Arendt, Reginald B. H. Tan, Richard D. Braatz</i>	
Growth Prediction for Molecular Crystals of Api-Complexity	242
<i>Ryan C. Snyder, Jacob P. Sizemore, Michael F. Doherty</i>	
Solution Speciation of Impurities: A Force Field Simulation of Its Impact On α - Glycine Crystal Habit	244
<i>Sendhil Poornachary, Pui Shan Chow, Reginald B.H. Tan</i>	

Quantitative Analysis of H-Bonding Interactions: Relation To Crystal Shape and Size	245
<i>Charles Acquah, Luke E. K. Achenie, Arunprakash T. Karunanithi, Shanthakumar Sithambaram, Steven Suib, Jose Gascon</i>	
Nanoparticle Formation of Highly Water-Soluble Pharmaceutical Coated with Poorly Water-Soluble Material by Using the Rapid Expansion of Water-in-Supercritical CO₂ Microemulsion	246
<i>Worawut Tempuwapat, Masahiro Ikeda, Hideki Ichikawa, Yoshinobu Fukumori, Atsushi Tsutsumi</i>	
Processing of Superparamagnetic Iron Oxide Nanoparticles by the Dense Gas Technology	255
<i>Un Teng Lam, Raffaella Mammucari, Neil R. Foster</i>	
Application of Supercritical Anti-Solvent To Synthesize Delivery Systems for A Sustained Release of Food Antimicrobials	256
<i>Minfeng Jin, Qixin Zhong</i>	
Visualization and Conception of the Atomized Rapid Injection for Solvent Extraction (Arise) Process for the Production of Highly Respirable Powders.....	257
<i>Roderick Sih, Neil R. Foster</i>	
Encapsulated Quercetin Particles Using a Supercritical Antisolvent Process	258
<i>Gunilla B. Jacobson-Andrews, Elizabeth M. Szilágyi, Can Quan, Charlotta Turner, Richard N. Zare</i>	
Estimation of Nucleation Kinetics From the Kinetic Limit of Metastable Zone Width.....	259
<i>Venkateswarlu Bhamidi, Sameer Talreja, Guangwen He, Paul J. A. Kenis, Charles F. Zukoski</i>	
Correlating Molecular Interactions with Solubility of Alpha-Amylase from Bacillus Licheniformis.....	260
<i>Chirag M. Mehta, Edward T White, James D Litster, Matthew T. Hardin, Abraham Lenhoff</i>	
Molecular Dynamics Simulation of the Hydration and Interaction between Bovine Insulin Hexamers	269
<i>Vishal Koparde, Kristen A. Fichthorn</i>	
Microfluidic Platforms for In-Meso Membrane Protein Crystallization	270
<i>Griffin W. Roberts, S.L. Perry, J.D. Tice, P.J.A. Kenis</i>	
Analysis of Concentration Field within an Evaporating Hanging Droplet	271
<i>Li May Goh, Richard D. Braatz</i>	
Crystallization of Spherical Agglomerates of a Peptide	278
<i>Shailendra Bordawekar, Samrat Mukherjee, John Tolle</i>	
Acceleration of the Formation Rates of Metal Nano Particles with A Sonochemical Process by the Addition of Microbubbles	279
<i>Satoshi Takeda, Hideo Tajima, Akihiro Yamasaki, Fumio Kiyono, Kazukiyo Kumagai, Yukio Yanagisawa</i>	
Particle Formation Pathways In Antisolvent Precipitation Processes.....	286
<i>Jan Sefcik, Anna Jawor-Baczynska, Barry D. Moore</i>	
The Effect of Impurities on Borax Decahydrate Crystallization in MSMR Crystallizer.....	287
<i>Birgul Benli, Nusret Bulutcu</i>	
Scale-Up Investigation of Particle Production In Emulsions	297
<i>Andreas Voigt, Michael Fricke, Kai Sundmacher</i>	
Membrane Emulsification for PolyD,L-Lactide-Co-Glycolide Acid Microparticle Production: Influencing Factors.....	298
<i>Gilda Gasparini, Serguei R. Kosvintsev, Richard G. Holdich</i>	
Droplet-Based Microfluidics for Monodisperse Particle Synthesis.....	306
<i>Nick Carroll, Christian Holtze, Sergio Mendez, Gabriel P. Lopez, David A. Weitz, Dimitar Petsev</i>	

Simulant Development for Savannah River Site High Level Waste	307
<i>Michael Stone, R. E. Eibling, D. C. Koopman, D. P. Lambert, P. R. Burket</i>	
Seeding--Friend or Foe?	314
<i>San Kiang, Chiajen Lai, Thomas LaPorte, Fernando Quiroz, Lori Spangler, Jean Tom, Zhongmin Xu</i>	
A High Intensity Emulsification Method for the Production of Nanoparticles	315
<i>Eric Jayjock, M. Silvina Tomasone, Fernando J. Muzzio</i>	
Precipitation of Micro/nanoparticles by Enhanced Energy Dissipating Impinging Jets in Stirred-Tank Reactors	316
<i>Giuseppe Di Benedetto, Ewa Sukcik, Piero M. Armenante, Somenath Mitra</i>	
Development of a Particle Size Analysis Method for Dry and Wet Granulation	317
<i>Jennifer Wang, Niranjana Kottala, Robert Jerzewski, Emil Friedman</i>	
Computational Modelling of the Anderson Cascade Impactor	318
<i>Eric Jayjock, Justin P. Lacombe, Fernando J. Muzzio</i>	
Controlled Nanoparticle Agglomeration as a Low-Density Dry Powder Aerosol Formulation Strategy	319
<i>Lianjun Shi, Laura J. Peek, Carl Plumley, Mark Bailey, Cory Berkland</i>	
Process Engineering Aspects of Plasmid-Based Biopharmaceuticals Production: Tackling the Threatening Vaccine Shortages to Prevent Global Pandemics	320
<i>Michael K. Danquah, Gareth M. Forde</i>	
Continuous Thermal Epimerization in High Temperature Tubular Reactor	324
<i>Amy Jines</i>	
Continuous Newman Kwart Rearrangement In Thermal Tube Reactor	325
<i>Martin Johnson</i>	
Controlling the Key Response Variables Through Scaling Rules During the Scale-Up of a Fluidized Bed Granulation Process	326
<i>Ecevit Bilgili, Jeff Ko, Adam Chen, Edward Smith, Pavol Rajniak, Kyle Fliszar, Gordon Wong, Larry Rosen, Daniel Grubb, Dafni Bika</i>	
Development and Scale-Up of Efficient Api Drying Using Fluid Bed Dryer	327
<i>Yubo Yang, Jenny Lau, Ilaria Popolla, Gerrie Liaw, Melissa Ostberg, Stephen Tyler</i>	
Quality Risk Analysis of a Tablet Coating Process	328
<i>Steve S. Y. Wang, Steven H. Chan, San Kiang</i>	
Novel Scaling of Rotary Drum Film Coating Developed from Commercialization of Pharmaceutical Tablets	329
<i>Alan R. Silverman, Jeffrey Givand, Brad Holstine, Michael Gentzler</i>	
Oral Absorption of Weakly Acidic Compounds	330
<i>Monica L. Adams, James Ormes, Ajit Thakur</i>	
Oral Delivery of Insulin-Transferrin Bioconjugates Using Intelligent Complexation Hydrogels	331
<i>Justin P. Shofner, Nicholas A. Peppas</i>	
Development of a Computer Program Predicting the Influence of Cyclodextrins On Oral Bioavailability of Insoluble Drugs: From Modeling To In Vivo Comparison	332
<i>Ece D. Gamsiz, Lee A. Miller, Avinash G. Thombre, Rebecca L. Carrier</i>	
Using Physically-Based Dissolution Simulations to Develop Ideal Particle Distributions in Tablets	334
<i>Dan Braido, Alberto Cuitino</i>	
A New Hypromellose Excipient for Direct Compression Controlled Release	340
<i>Karl Jacob, Kacey Ender, Tim Cabelka, Dan Denomme, Dave Wallick</i>	

Sublingual Drug Delivery; Will It Always Give 'Fast Onset'? A Product Enhancement Perspective	341
<i>Jeremy A. Bartlett</i>	
Conversion of Chord Length Distribution To Particle Size Distribution In Needle Systems	342
<i>Sze Wing Wong, Christos Georgakis</i>	
Observation of Polymorphic Change Through Analysis of FBRM Data: Applications	344
<i>Stephanie Barthe, Martha Gallivan, Ronald W. Rousseau</i>	
Relationship between Particle Size Distribution and Chord Length Distribution	345
<i>Pui Shan Chow, Zai Qun Yu, Reginald B.H. Tan</i>	
In Situ PSD Monitoring At High Solids Concentration Using Video Imaging and Statistical Estimation	346
<i>Paul A. Larsen, James B. Rawlings</i>	
Real-Time Particle Size and Shape Characterization Using In-Process Video Imaging Process Analytical Technology (PAT) In Dynamic Processes	347
<i>Eric J. Hukkanen, Terry P. Redman</i>	
Automated Control of Batch Cooling Crystallization Using FBRM	348
<i>Pui Shan Chow, Jia Wei Chew, Reginald B.H. Tan</i>	
Pharmaceutical Engineering as an Emerging Academic Field - Challenges and Opportunities	349
<i>Piero M. Armenante</i>	
Technology Roadmap for Pharmaceutical Development and Manufacturing (No abstract)	350
<i>Gintaras V. Reklaitis</i>	
NSF Engineering Research Center for Structured Organic Particulate Systems (No abstract)	351
<i>Fernando J. Muzzio</i>	

Author Index