Leveraging a Research Budget Through IFPRI

Willie Hendrickson, President
Why Is Particle Science and Technology Important?

- Ubiquitous throughout all industrial manufacturing
- Small changes in particle related processes and properties can have huge effects on productivity and profitability
- Particle technology is never the focus in development until it is too late
Examples of Particle Technology Challenges

- Powder flow from hoppers
- Powder segregation during handling
- Inconsistent slurry properties
- Particle size variations on raw materials
- Variations in drying
Where Do You Find Expertise, Suggestions or Answers?

- Corporate Engineering
- Academic Literature
- Consultants
- Internet
- IFPRI
IFPRI History

Started in 1979 by:

• 5 professors
  – Pfeffer
  – Leschonski
  – Inoia
  – Scarlett
  – Tiller

• 12 international companies
  – DuPont – Unilever
  – Standard Oil Of Indiana – Eastman Kodak
  – Bethlehem Steel – US Steel
  – Exxon – P&G
  – British Nuclear Fuels – 3M
  – Alcoa – ICI
Original Observations and Mission of IFPRI

- Lack of fundamental particle science understanding
- Lack of forum for intercompany discussion
- Poor connectivity between universities and industry
- Provide venue for particle technology discussion
- Develop strategic plan for particle science
- R&D focus on industry concerns
IFPRI Technical Program

Dynamic - responds to Member Company needs
Managed within 5 Subject Areas which have strong interactions and weak boundaries

Transition from wet to dry
- Sols & Dispersions
  - Flow / Separations
- Dry Powder Flow

Interparticle Forces
- Characterization & Measurement
  - Particle Formation
- Size Reduction

Attrition
- Engineered Products
<table>
<thead>
<tr>
<th>Type</th>
<th>Technical Area</th>
<th>Project Description</th>
<th>Research Associate</th>
<th>Institute</th>
<th>Renewal Date</th>
<th>End Date</th>
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<tr>
<td>Characterization</td>
<td>Effect of Electrostatics on Particle Packing</td>
<td>M. Quintilla</td>
<td>U. Seville</td>
<td>2016</td>
<td>2019</td>
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<td>Formation</td>
<td>Creating Tunable Agglomerates via 3D Printing</td>
<td>K. Hapgood</td>
<td>Monash U.</td>
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<td>2020</td>
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<td>Powder Structure Control</td>
<td>R. Kohlus</td>
<td>U. Hohenheim</td>
<td>2014</td>
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<td>Relating Compaction Performance and Behavior to Process Conditions</td>
<td>A. Zavaliangos</td>
<td>Drexel U.</td>
<td>2015</td>
<td>2018</td>
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<td>Molecular Self Assembly</td>
<td>U. Weisner</td>
<td>Cornell U</td>
<td>2018</td>
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<td>Spray Drying at High Temperatures</td>
<td>A. Bayly</td>
<td>U. Leeds</td>
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<td>Dry Systems</td>
<td>Die Filling of Aerated Powders</td>
<td>C. Wu</td>
<td>U. Surrey</td>
<td>2016</td>
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<td>Dry Powder Rheology</td>
<td>K. Daniels</td>
<td>NCSU</td>
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<td>Flowability Assessment of Weakly Consolidated Powders</td>
<td>C. Hare and A. Hassenpour</td>
<td>U. Surrey</td>
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<td>Wet Systems</td>
<td>Deliquoring of Solvent Wet Cakes</td>
<td>H. Anlauf</td>
<td>KIT</td>
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<td>Formations</td>
<td>Sticking of Powders to Equipment Surfaces</td>
<td>S. Beaudoin</td>
<td>Purdue U.</td>
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<td>Size Reduction</td>
<td>Surface and Structural Transformations in Milling</td>
<td>M. Descamps</td>
<td>U. Lille</td>
<td>NA</td>
<td>2016</td>
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IFPRI Industrial Membership

- **FINE CHEMICAL**
  - Syngenta
  - Corbion
  - Novozymes

- **PHARMACEUTICAL**
  - Merck
  - Eli Lilly
  - AbbVie
  - Roche

- **CONSUMER GOODS**
  - Procter & Gamble
  - Unilever

- **ASSOCIATE MEMBERS**
  - PSE
  - Hosokawa (Europe)
  - AVEKA, Inc.
  - Freeman Technologies
  - Paul O. Abbe
  - Horiba

- **GENERAL CHEMICALS**
  - DuPont
  - DSM

- **STEEL**
  - Nippon Steel

- **SPEC. CHEMICALS**
  - Corning
  - Johnson Matthey
  - UOP
  - Almatis
  - Evonik
  - Duracell

- **POTENTIAL NEW MEMBERS**
  - Sandvik
  - Imerys
  - Mondelez
  - Air Products
  - Chemours
  - Pfizer
  - Restek
IFPRI Deliverables

• Annual general meeting
• Winter business meeting
• 10-12 annual research reports
• Over 600 commissioned reports and reviews
• 2-3 reviews annually
  • Workshops
  • Roundtables
• Intensive technical interaction
Annual General Meeting

- Five Day Meeting
  - 2014 University of Edinburgh
  - 2015 Cornell University
  - 2016 University of Surrey
Annual General Meeting

- Particle technology reviews
- Project overviews
- Project brief writing
- Bob Pfeffer seminar series
- Student poster session
- Proposal and brief voting
- Business meeting
38th Annual General Meeting

June 12-16, 2016

Horsley Conference Center
Surrey, United Kingdom

Host: Professor C.-Y. Wu
Deliverable Example

• Focused workshop on particle formation
• 2 day technical overviews, breakout sessions, consensus building
• Program proposals
Workshop Outcome

- Defined two areas of interest
  - Standard particle
  - Best practices
- Wrote project brief on standard particle
- Received 3 proposals
- Voted on funding Karen Hapgood at Monash on 3D printing
Predicting Crystallization Behavior Workshop

June 19th – 20th, 2015
Ithaca, NY, USA

Workshop Chairs: Dr. Neil George and Professor James Litster

**Plenary speakers:**
- Prof. Dr. Gerard Coquerel, Univ. Rouen
- Prof. Dr. Michael Doherty, Univ. Santa Barbara
- Dr. Rob Geertman, DSM
- Dr. Daniel Green, DuPont
- Dr. Paul Meenan, Pfizer
- Prof. Dr. Sarah Price, UC London
- Prof. Dr. Joop ter Horst, Univ. Strathclyde
- Prof. Dr. Elias Vlieg, Univ. Nijmegen

**Invited participants:**
- Dr. Keith Chadwick, Univ. Purdue
- Dr. Denis Gebauer, Univ. Konstanz
- Prof. Dr. Kevin Roberts, Leeds Univ.
- Prof. Dr. Ronald Rousseau, Georgia Tech
- Dr. Thomas Vetter, Manchester Univ.
- Prof. Dr. Ulrich Wiesner, Cornell Univ.
- Prof. Dr. Michael Zoworotko, Univ. Limerick
IFPRI Shear Testing Roundtable Discussion

- IFPRI Member Roundtable January 2015
  - Intent of flowability measurements
  - What devices or methods employed
  - Number of samples measured
  - Who conducts the tests
  - What problems are encountered
  - Unmet needs
  - Is this a topic for further IFPRI sponsored R&D
General Conclusions

- Broad research portfolio serving diversified membership
- Projects provide new relevant scientific knowledge for membership
- IFPRI academic associates are world-class authorities providing a unique global network and forum in particle technology
- Workshops and roundtables focus on intercompany discussions of best practices and development of strategic plan for particle technology
- Full profit of IFPRI membership is based on an active participation among members and contractors
For additional information contact
Willie Hendrickson, IFPRI President

Call: 651-730-1729
Email: whendrickson@aveka.com

Thank you!