

AVEKA Group

Blending: It is Never as Easy as it First Appears

September 23, 2021

Particle Processing Services

Toll Manufacturing

Research & Development

Innovative Solutions



PRESENTED BY: WILLIE HENDRICKSON, CEO & FOUNDER

Presentation Outline

- Overview of AVEKA
- Particle Processing 101 – The Big 6
- Brazil Nuts and Powdered Sugar Doughnuts
- Blending Methods
- Derek Geldart and powder flow/fluidization
- Examples
- Opportunities
- Conclusions

AVEKA Group Overview

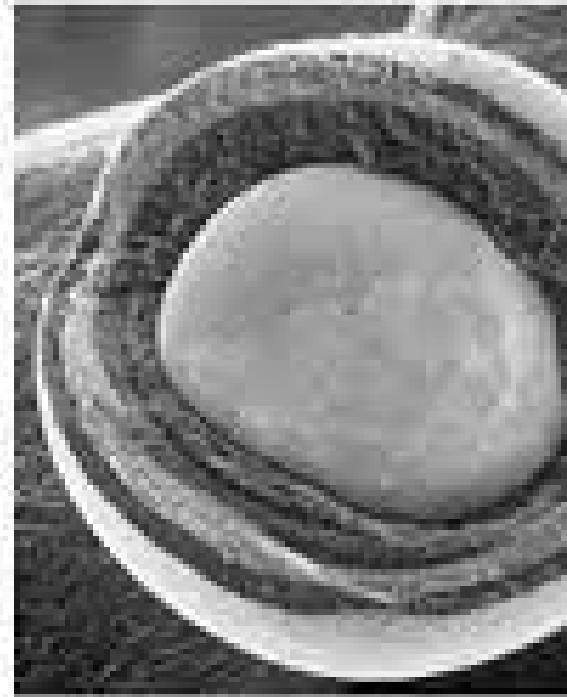
- Particle technology company focused on contract manufacturing
- Spin-off of 3M in 1994
- Comprised of 5 separate companies
- ISO certifications / food-grade certifications
- Currently 290 employees



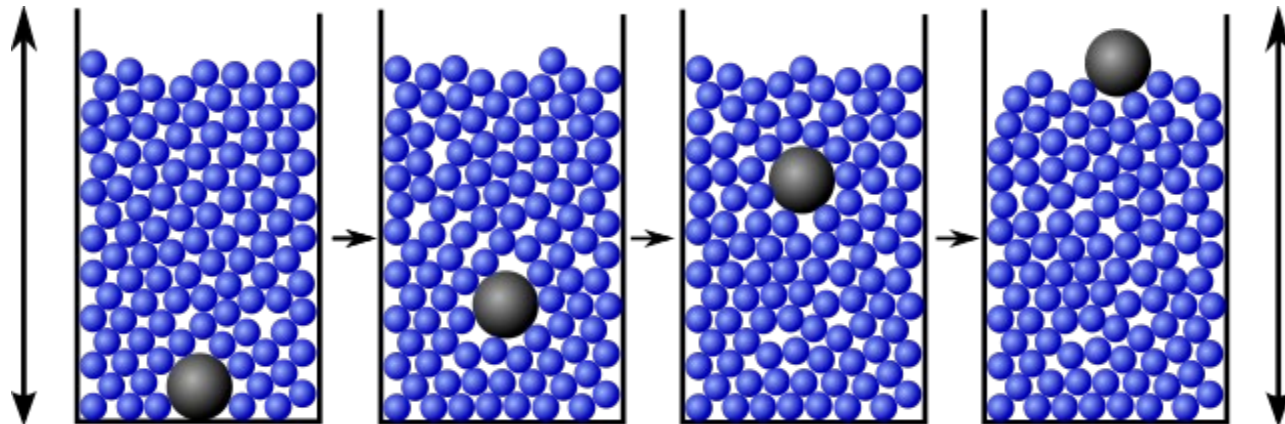
Particle Processing

The Big Six:

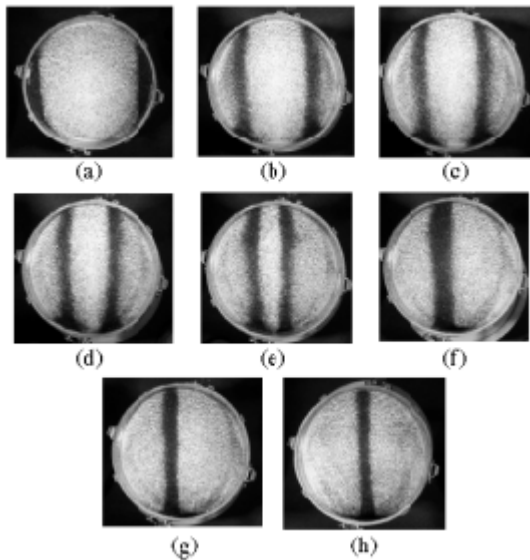
- Characterization
- Flow/Blending
- Size Reduction
- Drying
- Agglomeration
- Particle Coating



Brazil Nuts and Powdered Sugar Doughnuts



What Conditions Should You Use?



Double Cone Blender
1.6 mm dark beads; 3.7 mm white
beads
High Rotational Speed

Muzzio and Shinbrot IFPRI Final Report Powder Mixing and Segregation 2001

Blending Whys and Challenges

- To improve final product uniformity
- Create new product with multiple components
- Enhance reactions
- Improve powder flow
- Uniformity
- Segregation
- Particle breakage
- Agglomeration
- Micro growth



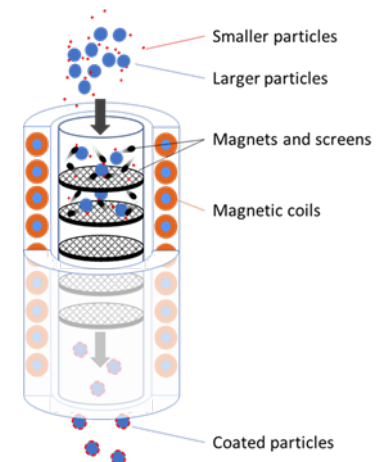
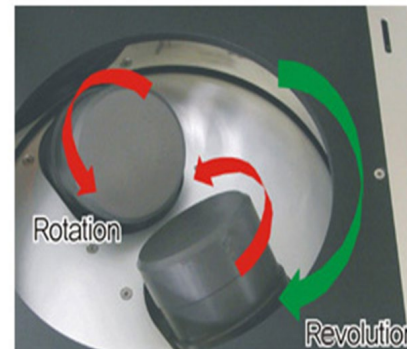
Blending Methods

- Ribbon Blender
- Forsberg Blender
- Plough Blender
- V-Blender
- Paddle Mixer
- Fluid Bed Dryer



Blending Methods (part II)

Acoustic Mixing
Tumble Mixing
Centrifugal Mixing
Spray Drying
Magnetically Assisted
Mixing
Funnel Mixing



Which Blender is the Correct Blender?

MAXIMUM DENSITY OF MATERIAL

Ribbon Blender	75 lbs/ft ³
Paddle Blender	75 lbs/ft ³
Nauta Mixer (cone)	200 lbs/ft ³
Double Cone	500 lbs/ft ³
V- Blender	500 lbs/ft ³

MATERIAL CHARACTERISTICS ON HIGHEST CAPACITY

Bulk Density	Lower
Particle Size	Small
Particle Shape	Spheres
Angle of Repose	Low
Cohesive/Adhesive	Cohesive
Moisture	Low/High

From Jeff Hoffmann, Paul O. Abbe



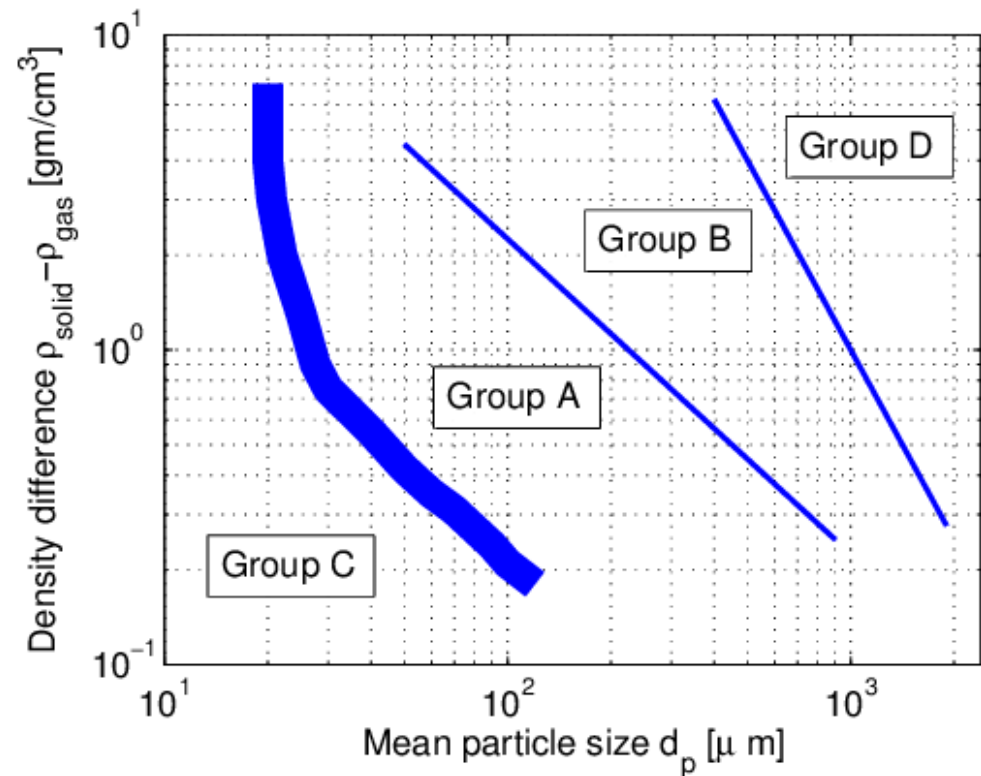
Processing Dilemmas

- Available equipment dilemma
- Volume/Scalability dilemma
- Powder flow dilemma
- Functionality dilemma



Geldart Particle Classification

Group A	Aeratable
Group B	Sand-Like
Group C	Cohesive
Group D	Spoutable



The Examples.... Finally

Standard Blending

- Food materials – ribbon
- Industrial chemicals – forsberg
- Minerals – v-blender

Blending Gone Bad

- Liquid addition and mixing

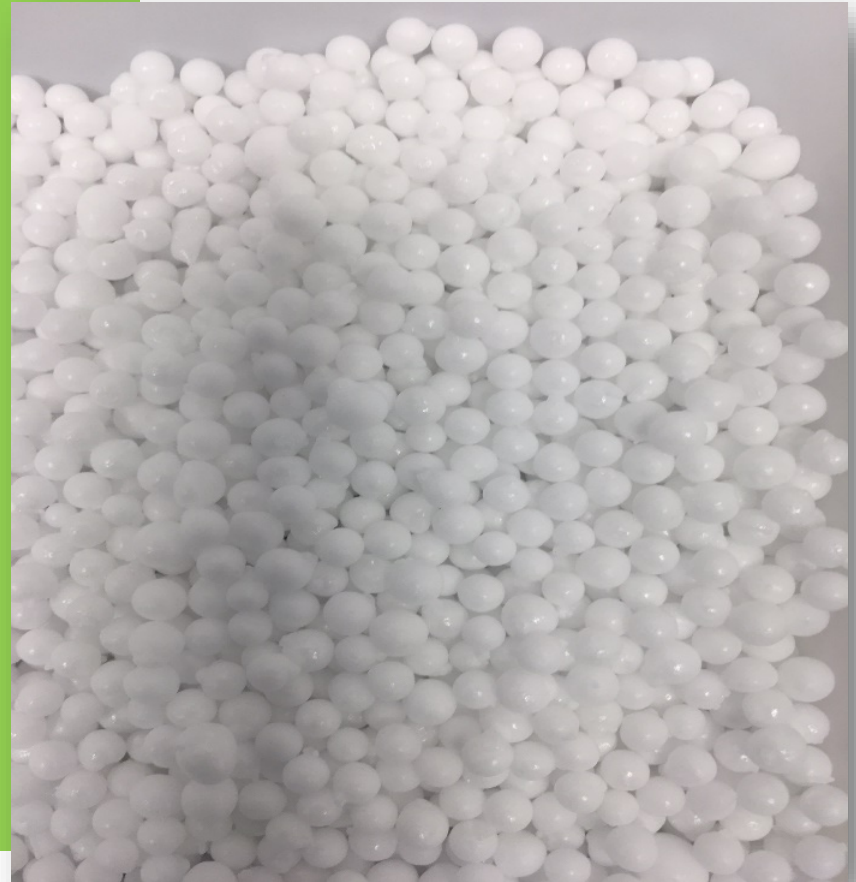
Clever and Unique Solutions

- Triturations
- Funnel flow
- Magnetic assisted mixing
 - Solids
 - Liquids and solids

❖ Statement of need

❖ How we approached the problem

❖ Why we chose a particular blending method



Blending Using Ribbon Blenders

Statement of challenge

- Food Powder Blending
 - Yeasts, starches, dry flavoring
 - Particles about the same size
 - No special requirements

The Result – straightforward and reliable



WHAT WENT WRONG?

- Nothing
 - This is standard process for food materials at AVEKA

THE REALITY

- Only real issues can be
 - Bag dumping
 - Formulation



Blending Using High Shear Mixing

Statement of challenge

- Continuous high-volume mixing
- Some liquid addition
- Post drying required

Results

- Blending up to 5000 lbs. per hour
- Small footprint
- Agglomeration minimized/maximized by controlling liquid feed rate
- Continuous post drying and screening may be needed



WHAT WENT WRONG?

- Nothing

THE REALITY

- Process in production
- When mixing and agglomerating – yields can be 60%. Recirculation needed

Blending Using V- Blenders

Statement of challenge

- Industrial ceramic material
- Up to 300 lbs/ft³
- Scalable
- Liquid addition possible

The Material



WHAT WENT WRONG?

- Cross Contamination
- Premature Dumping
- Blending straight forward and consistent

THE SOLUTION

- Protocol
- Training, maintenance, training

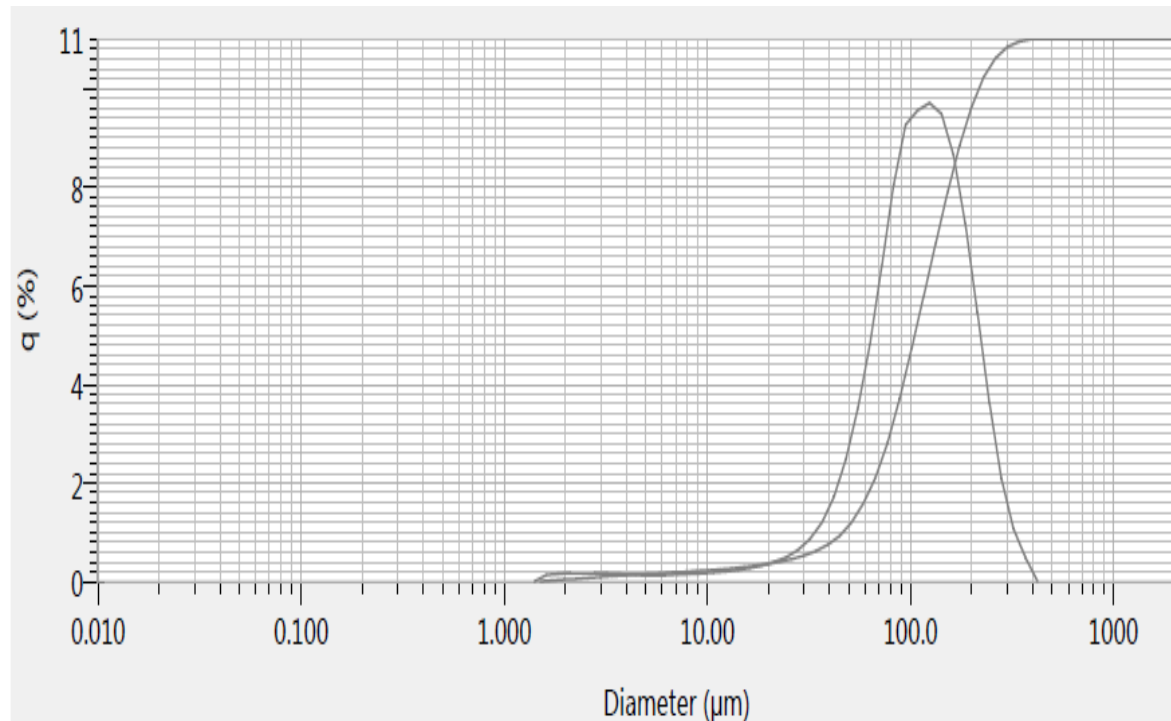
Blending Gone Bad

Statement of challenge

- Uniformly add water to dry food product
- % moisture <1% to 5%
- Ribbon blender and spray atomization

The Result

- PSD changed slightly due to water absorption and particle swelling

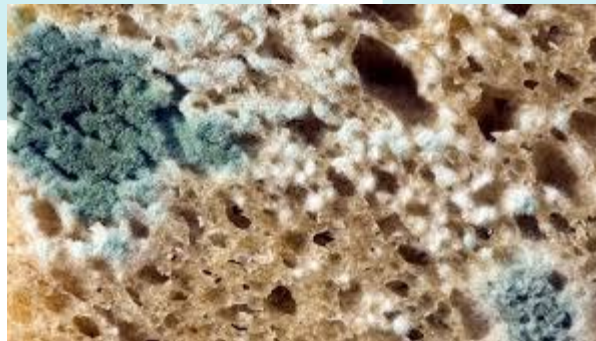


WHAT WENT WRONG?

- Nothing –blending was straight forward
- Everything - incredible micro growth

THE REALITY

- Water was not uniformly distributed - wet spots allowed bacterial growth



Blending of Micro Ingredients

Statement of challenge

- Uniform blend of inert ingredient with micro amount of functional ingredient
- Work done by Alice Wilkinson from Watson
- Trituration

The Solution

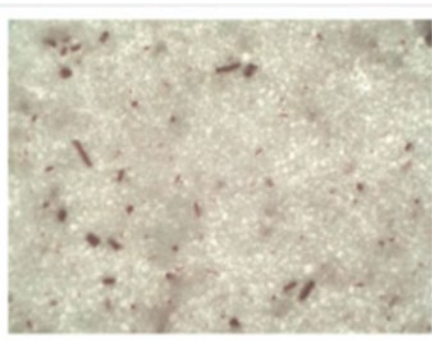
Example: Vitamin B12 (100% RDI – 6 µg)

• **100 mesh = 1.2 µg per particle**

100% RDI	➡	5 particles/serving
50% RDI	➡	2.5 particles/serving

• **Coat B12 on 100 mesh carrier @ 1% w/w.**

100% RDI	➡	500 particles/serving
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WHAT WENT WRONG?

- Nothing
- Brilliant solution to blending uniformity

THE REALITY

- Process used by Watson to sidestep mixing challenge



Blending of Large Particles with Small Particles

Statement of challenge

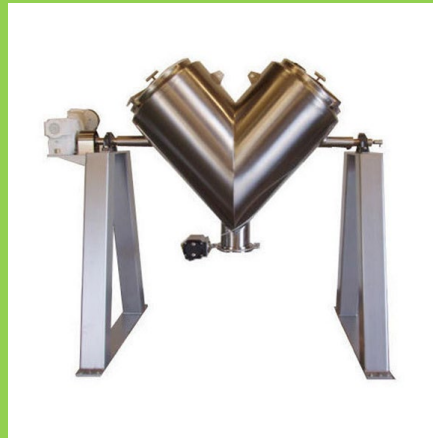
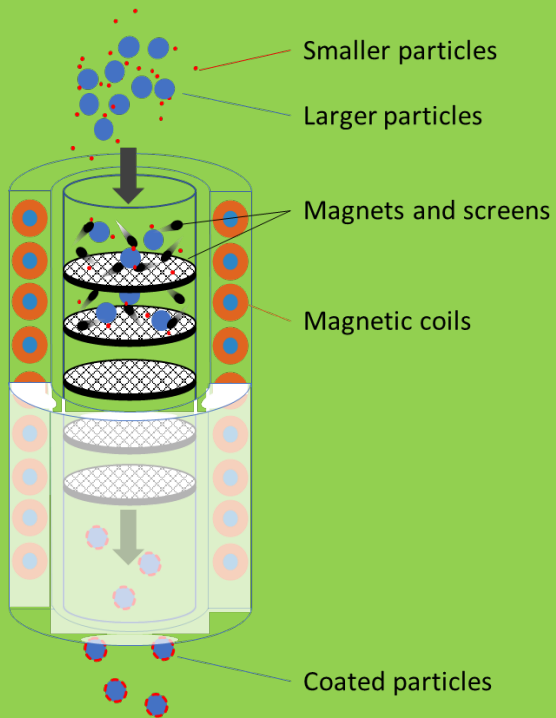
- Fumed silica
- Improvement of powder flow
- Continuous process
- Stable composite particle

The Solution

- Magnetically Assisted Impact Coating (MAIC)
- Measurement of process on flow
- Mechanistic Analysis



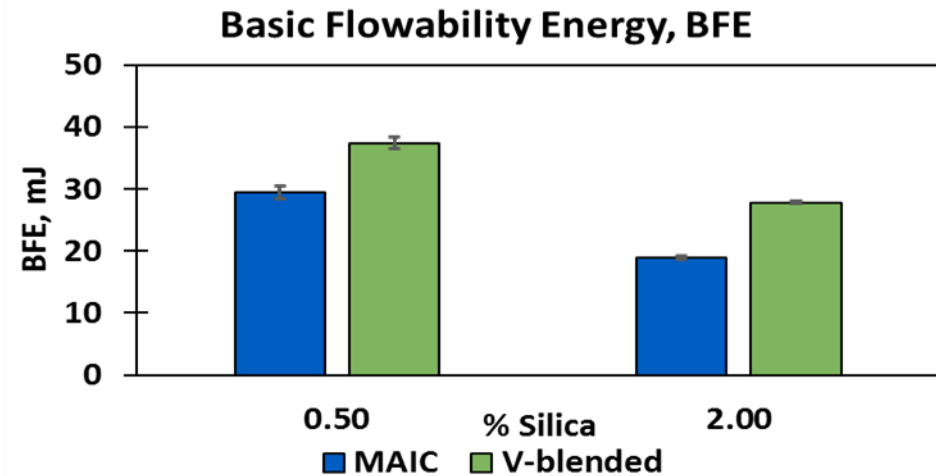
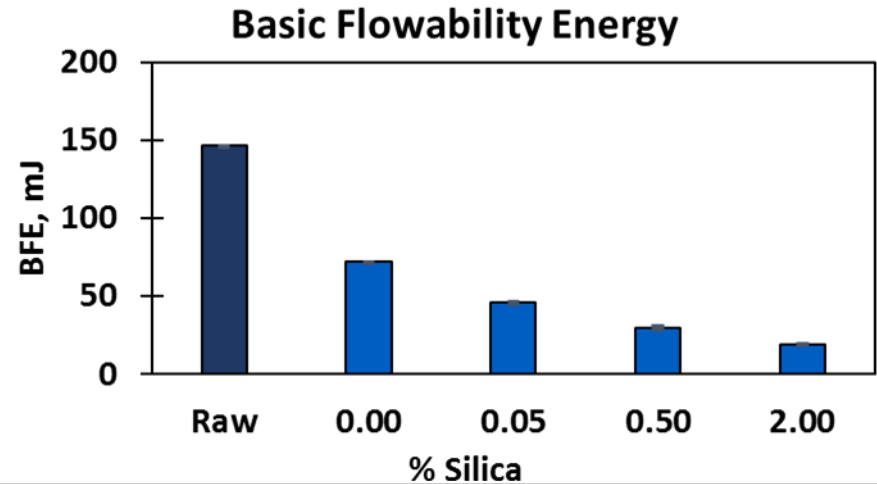
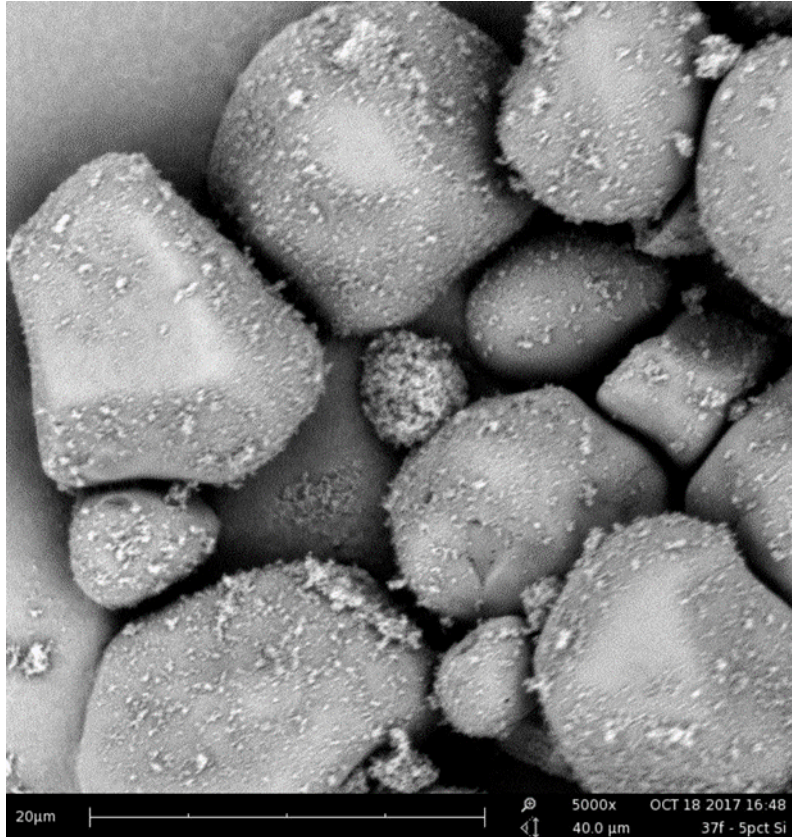
Mixing Methods



Measurement Methods



Results



WHAT WENT WRONG?

- Nothing
- Very consistent results

THE REALITY

- Process in production for 25 years

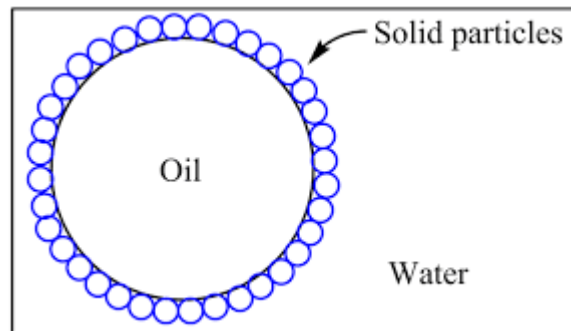
Blending of Liquids with Small Particles

Statement of challenge

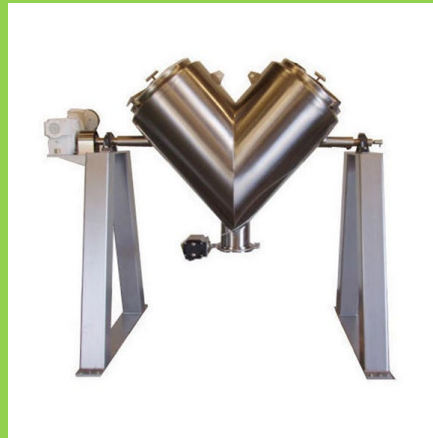
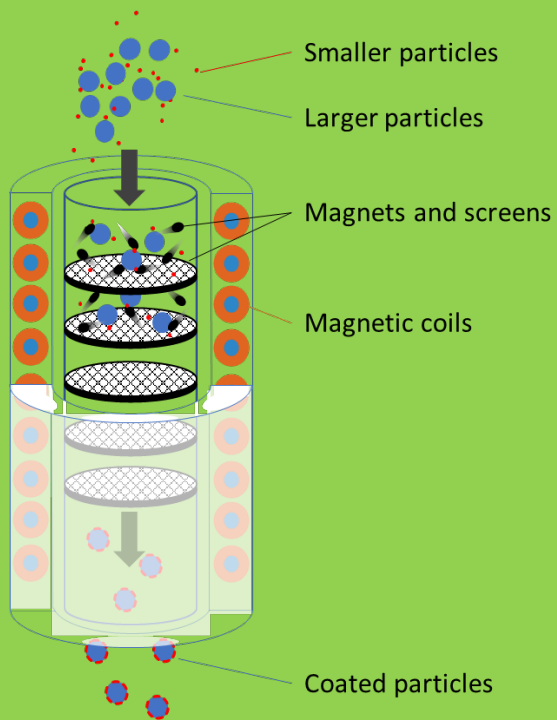
- Submicron powders
- < 1% liquid addition
- Develop continuous process
- Uniform Blend

The Solution

- Magnetically Assisted Impact Coating (MAIC)



Mixing Methods



Measurement Methods



WHAT WENT WRONG?

- Nothing
- Very consistent results

THE REALITY

- Process in production for 17 years

Mixing Using Funnel Flow

Statement of challenge

- Mix segregated materials during mass transfer
- No moving parts

The Result



<https://www.youtube.com/watch?v=MUr3H-M-nRk>

WHAT WENT WRONG?

- I never knew about this until this week

THE REALITY

- Need to try this mixing method in a plant

So... What Did I Leave Out?

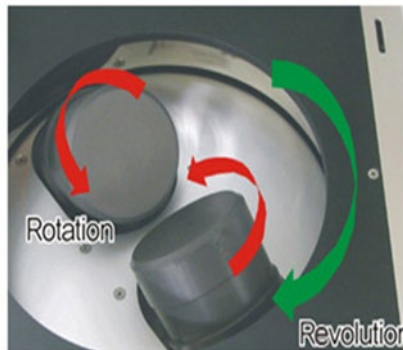
Major Uses Of Mixing

- Pharmaceuticals
- Friable powders (cereals)
- Color control
- Pastes and slurries



Equipment Variations

- Batch vs. continuous mixing
- Scale up of lab systems



Fluid Bed Processing Thoughts

Resources

International Fine Particle
Research Institute (IFPRI)

www.ifpri.net

Paul Mort Purdue University
(pmort@purdue.edu)

Karl Jacob University of Michigan
(kvjacob@umich.edu)

Jeff Hoffmann Paul O. Abbe
(jeffhoffmann@pauloabbe.com)

Ideas For The Future

Back to the Future

- Funnel Mixing

Summary

- Blending can be straight forward but:
 - Uniformity
 - Micro ingredients
 - Segregation
- Process conditions and materials are critical
- Be prepared to be surprised even with simple systems

Contact Information

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