AVEKA Group

PARTICLE PROCESSING SERVICES

TOLL MANUFACTURING

RESEARCH & DEVELOPMENT

INNOVATIVE SOLUTIONS

WILLIE HENDRICKSON, CEO & FOUNDER

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 230 employees

AVEKA's Vision

be the recognized leader in
innovative manufacturing solutions
for particle technology

AVEKA's Mission

be the leader in **particle processing**
by providing our customers with custom solutions,
quality manufacturing and **excellent customer service**

Specialty Materials Processing

- Liquid slurry receiving
- Filter press concentration
- Fluid bed drying
- Vacuum packaging

Specialty Materials Processing

Breaking ground to production

- 18 weeks
- MCC Room
- Liquid receiving bay
- Processer Room
- Equipment install and qualification
  - 4,250 kg fluid beds
  - Filter press
  - Extruder
  - Packaging

Particle Drying Services

- Spray drying
- Fluidized bed drying
- Roll drying / drum drying
- Tray drying

Fires During Processing

Problem:

- Provide encapsulated Omega-3
- Omega-3 very sensitive to oxidation
- Spray drying Omega-3 can cause dryer fires

Solution:

- Minimize exposure to air
- Larger particle size
- Roll drying vs. spray drying

The AVEKA Group

AVEKA Inc

- 61 people
- Corporate Headquarters
- R&D, Manufacturing, Specialty Process Suites

AVEKA Manufacturing

- 85 people – Fredericksburg, Iowa
- Large scale manufacturing
- Spray Drying, Hammer Milling, Fluid Bed Drying, Tumble Coating

Cresco Food Technologies

- 45 people – Cresco, Iowa
- Food Processing
- Spray Drying, Prilling, Drum Drying, Extraction, Wet Blending

AVEKA Nutra Processing

- 30 people – Waukon Iowa
- Value Added Food Processing
- Spray Drying, Roll Drying, Microfiltration/Nanofiltration, Specialty Separations

AVEKA CCE Technologies

- 9 People – Cottage Grove, Minnesota
- Industrial Materials, Abrasives, Ceramics, Minerals
- Jet Milling and Classification

Particle Characterization

Particle size analysis

- Particles 1 nm to 2+ mm
- Particle size distribution (PSD)
- Sonic sieving
- Rototap

Imaging

- Optical microscopy
- Scanning electron microscopy (SEM)

Surface area analysis

True density analysis

- Helium pycnometry

Formulation analysis

- High performance liquid chromatography (HPLC)
- Thermogravimetric analysis (TGA)
- Spectrophotometer
- Differential scanning calorimetry (DSC)

Flow characteristics

- Zeta potential analysis (ZP)
- Rheological analysis
- Moisture and solids analysis (MSA)
- Karl Fisher

Crushing Line

- Komar Industries auger crusher
- Tote tipper feeder
- Pneumatic conveying to screener

Crushing and Grinding Optimization

- 2003, D_{50} = 15-35 µm
- 2006, D_{50} = 18-24 µm
- 2013, D_{50} = 16-19 µm
- 2014, D_{50}= 17-19 µm

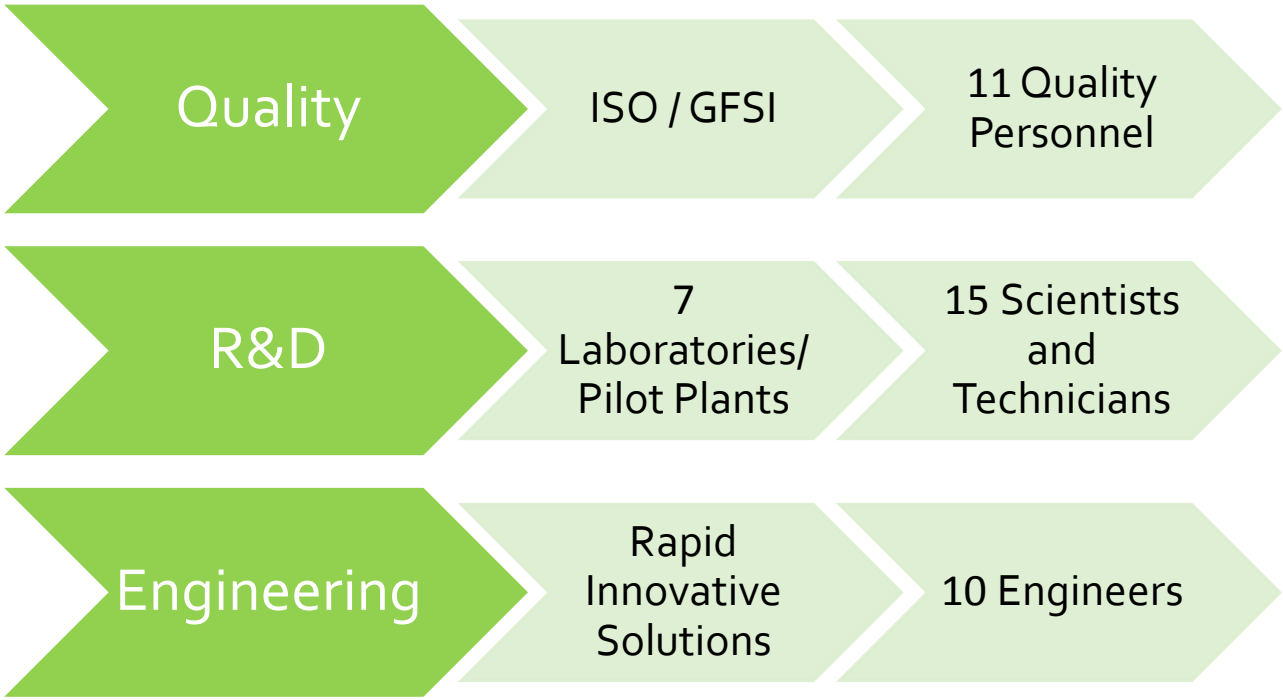
In 2012, seasonal cyclic behavior of PSD was noted and a customer/AVEKA DMAIC initiated

DMAIC Results and Questions

- PSD results (D_{50} =15-35 µm →16-19 µm) realized by adding proprietary grinding aid
- This proprietary addition not sufficient for total PSD control
- Control of ball mill temperature as critical as proprietary addition

Quality, R&D, Engineering

Fast Implementation, New Processing Questions, Quality Products



Dry Grinding

- Pre-crushing
  - Jaw crushing
  - Auger crushing
- Hammer milling
- Cryo milling
- Ball milling
- Jet milling

AVEKA CCE Technologies

- Fluid bed jet milling
- High-efficiency centrifugal air classifiers
- Equipment sales & service
- Toll processing

Jet Milling Glass

Challenge:

- Produce high yield
- Tight cut from crushed glass

Problems:

- Fines stick to coarse particles
- Yields are low (42%)

Solution:

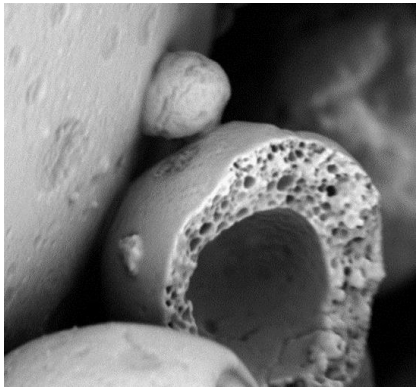
- Balance input energy and cut points
- Increase yield (54%)

Processing Technologies

Spray Drying	Grinding Milling	Classification / Screening
Blending	Roll Drying	Fluidized Bed Drying
Prilling	Particle Coating	Microencapsulation / Bead Making
Extraction	Purification	Microfiiltration / Nanofiltration

Microencapsulation Methods and Capsule Types

Payload Types: fragrances, oils, dyes, drugs, food additives, inks, . . .

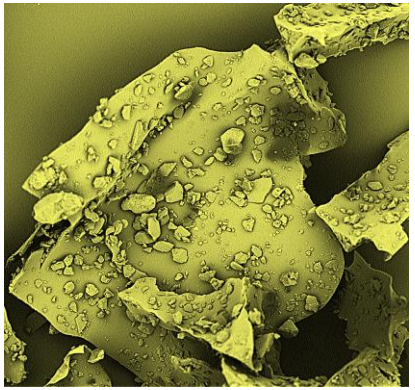


Core-shell

- Spray drying
- Coacervation
- Tablet coating
- Wurster coating
- Coaxial extrusion

Matrix

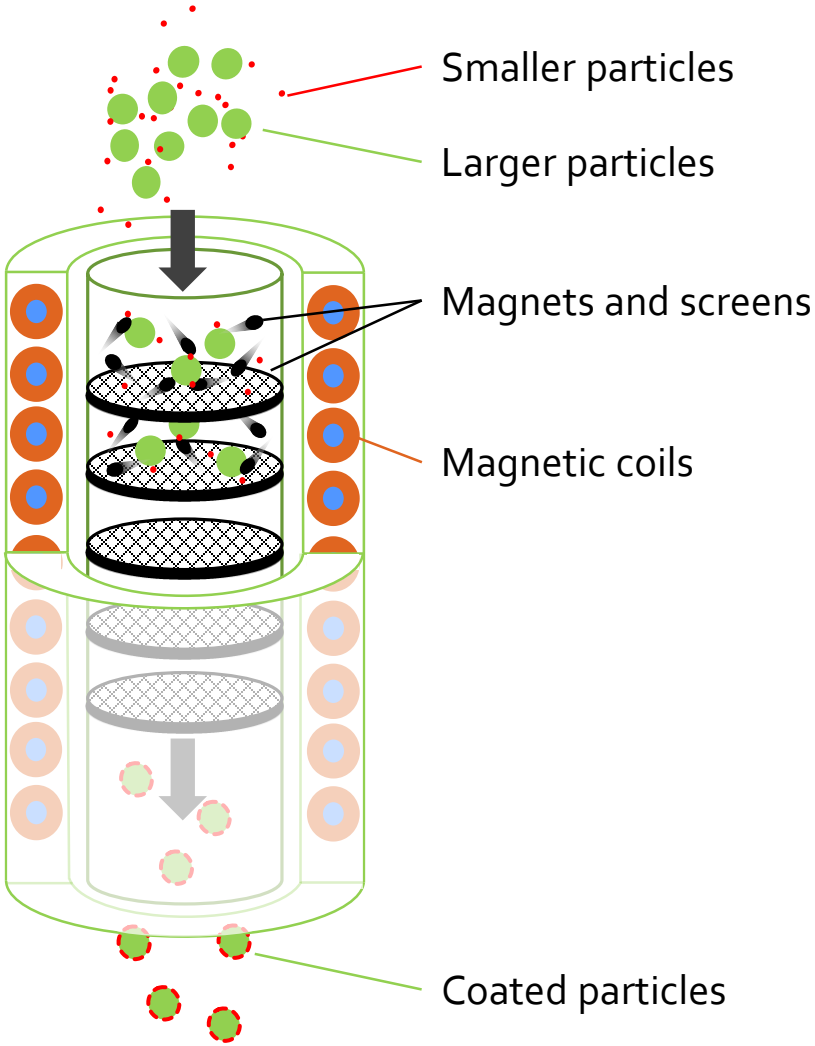
- Prilling
- Organogels
- Precipitation
- Emulsion polymerization



Plating

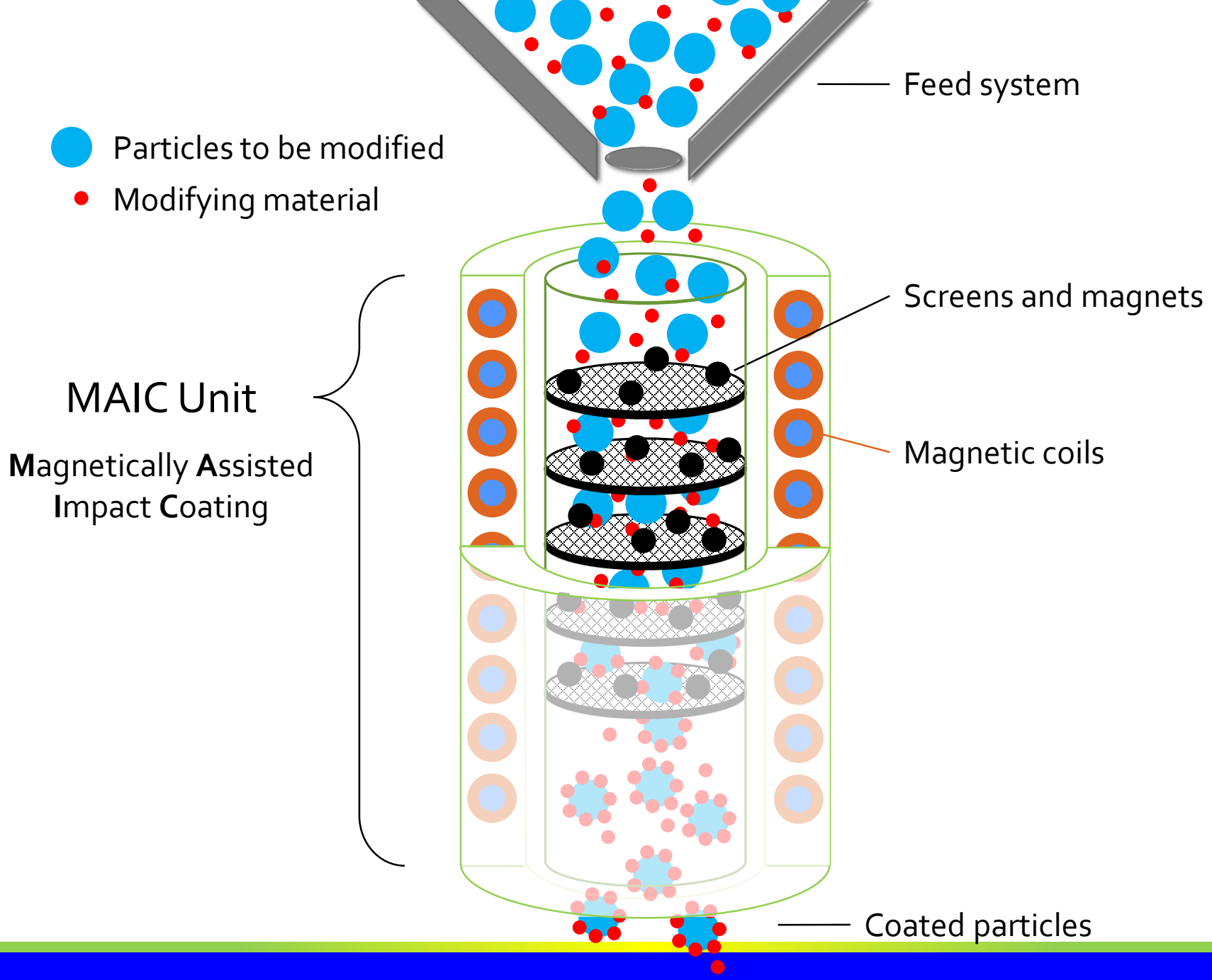
- Incipient wetness
- MAIC

MAIC: Magnetically Assisted Impact Coating

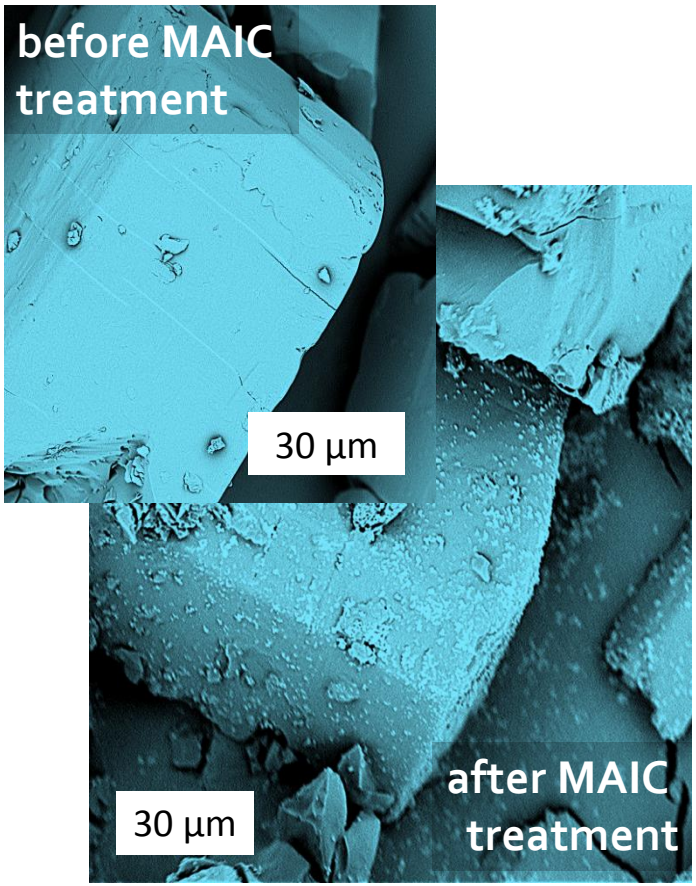


Particle Surface Treatment:

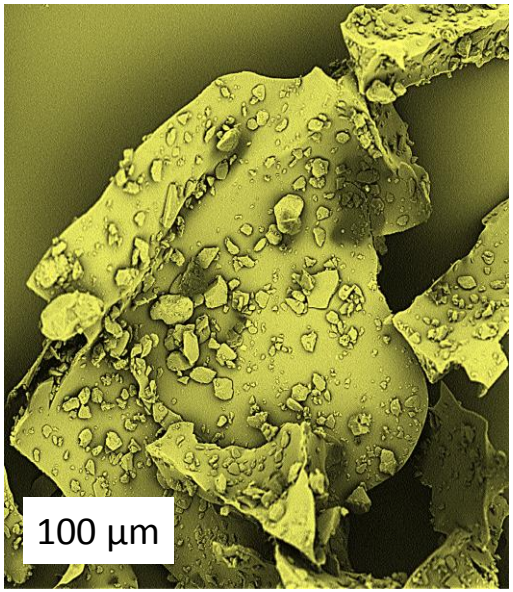
- Add flow agents (silica)
- Coat with solids (TiO_2, ZnO)
- Distribute liquids (silanes)
  - US Patent 5,962,082
- Can be used for many applications and industries
  - Agriculture materials, cosmetics, pigments, catalysts

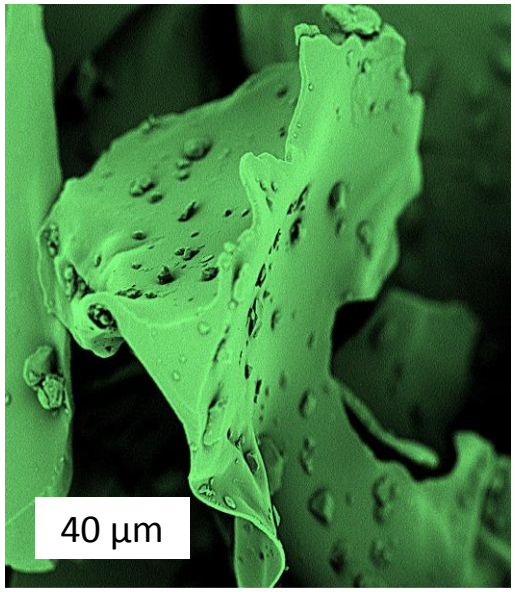

Particles to be modified
Modifying material
Feed system
MAIC Unit
Magnetically Assisted
Impact Coating
Screens and magnets
Magnetic coils
Coated particles

MAIC: Magnetically Assisted Impact Coating



After MAIC Treatment





Add surface functionality
with solids or liquids

"The AVEKA Advantage"

Wide range of process capabilities

Innovative solutions

R&D

Engineering

Strong quality system

Excellent customer service

Partnering approach

Commitment to health, safety & environmental

Flexible approaches

Summary

- Innovative manufacturing solutions
- Unique perspective – diverse markets
- Novel particle technology

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