Hosokawa Mixer Selection

“How difficult can it be!”

Daan Goris
Hosokawa Micron B.V.
Established in 1916
Production facilities in 5 countries
10 R&D and test centres world-wide
1600 Employees
HOSOKAWA business worldwide

- Powder Processing Technologies:
- Blowing Film Technologies:
HOSOKAWA Powder Processing Technologies

- Milling
- Classifying
- Mixing
- Drying
- Particle size enlargement
  - Compaction
  - Agglomeration
- Containment
- Nano technology
HOSOKAWA Micron BV - Netherlands

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Technology center for:
- Mixing
- Drying
- Agglomeration
“The reorientation of particles relative to one another in order to achieve uniformity”
Mixer Selection Parameters:

- Powder characteristics
- Recipe
- Quality requirements
- Batch size / capacity
- Charging sequence
- Product degradation
- Reaction time (chemical / heat transfer)

- Type of mixer (mixing efficiency)
- Installed power (mixing energy)
- Mixing speed

Mixing time
Mixer Selection Chart: (Models)

Free-flowing powders
- Low-shear mixers
  - Segregation problems?
    - NO: Horizontal Ribbon Mixers, Silo Mixers, Vertical Ribbon Mixers
    - YES: Vrieco Nauta, Screw mixers

Mid-shear mixers
- Vitomix
  - Conical paddle mixer

Cohesive powders
- High shear mixers
  - Extrudomix
    - Cyclomix
- Impact mixers
  - Flexomix
    - Turbolizer
    - Nobilta
- Particle design
  - Mechanofusion
    - Cyclomix
**Powder Characteristics:**

“Free flowing powders”

- Relatively small **inter-particle** forces
- Dry material
- Particle size > 75 µm
- Material can be conveyed and stored easily
- Tendency to segregate
- Typical mixing technologies

![Diagram showing powder characteristics with symbols for percolation, vibration, and transportation.](image-url)
Visualization of a mixing process

Before mixing

Material A  Material B

Mixing

Random Mixing

After mixing
Powder Characteristics

“Cohesive powders”

- Inter-particle forces
- Dry / wet material
- Particle size <75 µm
- Poor flow characteristics
- Attention for conveying - storage
- Considered as stable mixtures
- Typical mixing technologies
Powder Characteristics

“Cohesive powders”

Cohesive Powder Mixture
Low Shear Mixing

Cohesive Powder Mixture
Intensive Mixing
Mixer Selection Chart: (Models)

Mixer selection

Free-flowing powders
- Low-shear mixers
  - Segregation problems?
    - NO
      - Horizontal Ribbon Mixers
      - Silo Mixers
      - Vriece Nauta
    - YES
      - Vertical Ribbon Mixers

Cohesive powders
- Mid-shear mixers
  - Vitomix
    - Conical paddle mixer
- High shear mixers
  - Extrudomix
    - Cyclomix
- Impact mixers
  - Flexomix
    - Turbolizer
    - Cyclomix
- Particle design
  - Mechanofusion
    - Nobilta
    - Cyclomix

Segregation problems?
Mixer Selection Chart: (mixing principals)

- Low shear Mixing
- Mid shear Mixing
- Shear Mixing
- Impact Mixing
- Particle Modification
Mixer Selection Chart: (Models)

- **Free-flowing powders**
  - Low-shear mixers
  - Segregation problems?
    - NO: Horizontal Ribbon Mixers, Silo Mixers, Vertical Ribbon Mixers
    - YES: Vrieco Nauta, Screw mixers
  - Mid-shear mixers: Vitomix, Conical paddle mixer
- **Cohesive powders**
  - High shear mixers: Extrudomix, Cyclomix
  - Impact mixers: Flexomix, Turbolizer, Cyclomix
  - Particle design: Mechanofusion, Nobilta, Cyclomix

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- Vertical Ribbon Mixers
- Screw mixers
Hosokawa Batch Mixers:

- Cyclomix
- Conical paddle mixer
- Vitomix
- Vrieco-Nauta® mixer
Mixer selection chart: (Batch operation)

Max. mixing intensity [W/kg] vs. Tip speed [m/s]

- **Intensive mixing**
  - Cyclomix
  - CPM-mixer
- **Convective mixing**
  - Vitomix
  - Vrieco-Nauta mixer

**Particle design**
Mixer selection: (product properties)

- Inter-particle forces
- Moisture content
- Particle strength
- Particle size distribution
- Particle morphology
- Cohesiveness
- Bulk density
- Physical characteristics
More Mixer selection criteria:

- Mixing accuracy
- Batch size
- Cleaning methods
- Validation
- Heating and cooling
- Charging and discharging
- Available space
- Yield after discharge
- Up and downstream process
- Safety issues
Case Study: Vrieco-Nauta® mixing application

Gelatin: Mixing of “heat” sensitive and fragile powders in Food and Pharmaceutical industry
**VN-mixer flow pattern:**

The planetary movement of the orbital arm causes a continuous exchange of particles.

The radial movement of the mixing screw conveys the material upwards.

In the center of the vessel, the product sinks by gravity.
Process/design requirements - Gelatin Mixing:

- Mixing batches of gelatin on particle size, protein content
- Mixing small % of additives into the gelatin
- Flexible process - variation in batch size from 2 – 25 tons
- Life- and feeding hopper before packing – No segregation
- No cross contamination between batches
- No product distortion / degradation
- No heat input during process
- Good cleanable dry
- Batch Identification
Case Study:

Cyclomix® mixing application

Intensive Mixing and Coating of Dry Powder Inhaler (DPI)
Dry Powder Inhalers: Issues

- Particles small enough to penetrate into the lungs
- Cohesive powder (API) on carrier
- Separate particles, dispersed in air, accurate dosing

Alveoli: < 1 micron

5 – 9 micron
3 – 5 micron
2 - 3 micron
1 - 2 micron
Balancing contradicting requirements:

- Mixing process needs to be intensive
- Mixing process with minimal mixing energy.
- Formulation needs to be stable
- Coated particles need to be unstable
DPI powder function:

Carrier particle,
High surface area,
high surface energy

Formulated material

Transportation,
storage and
dosing of API

Separation of Carrier and API particles

Lungs
Formulated DPI-powder:
Cyclomix Flow Pattern:

- Impact Mixing
- Shear Mixing
- Impact dispersion
- High shear coating
The Cyclomix for DPI production:

- Perfect dispersion of fines
- Accurate temperature control
- Powder shape manipulation
- Single layer coating effect
- Validated mixing process for hardware and software
- Mixer filling rate between 30-100%
- Pharmaceutical design standards
- Maximum yield
- Validated cleaning process
Questions?

If your question was not answered during this session, we will contact you shortly to answer your specific question.

Or you can contact:

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