



TJETJEN
— DAS ORIGINAL —

Energy Efficiency in Grinding for Petfood

Challenges and Solutions

Thomas Runde, CEO

Sao Paulo, May 15th 2025



The Grinding People

Agenda

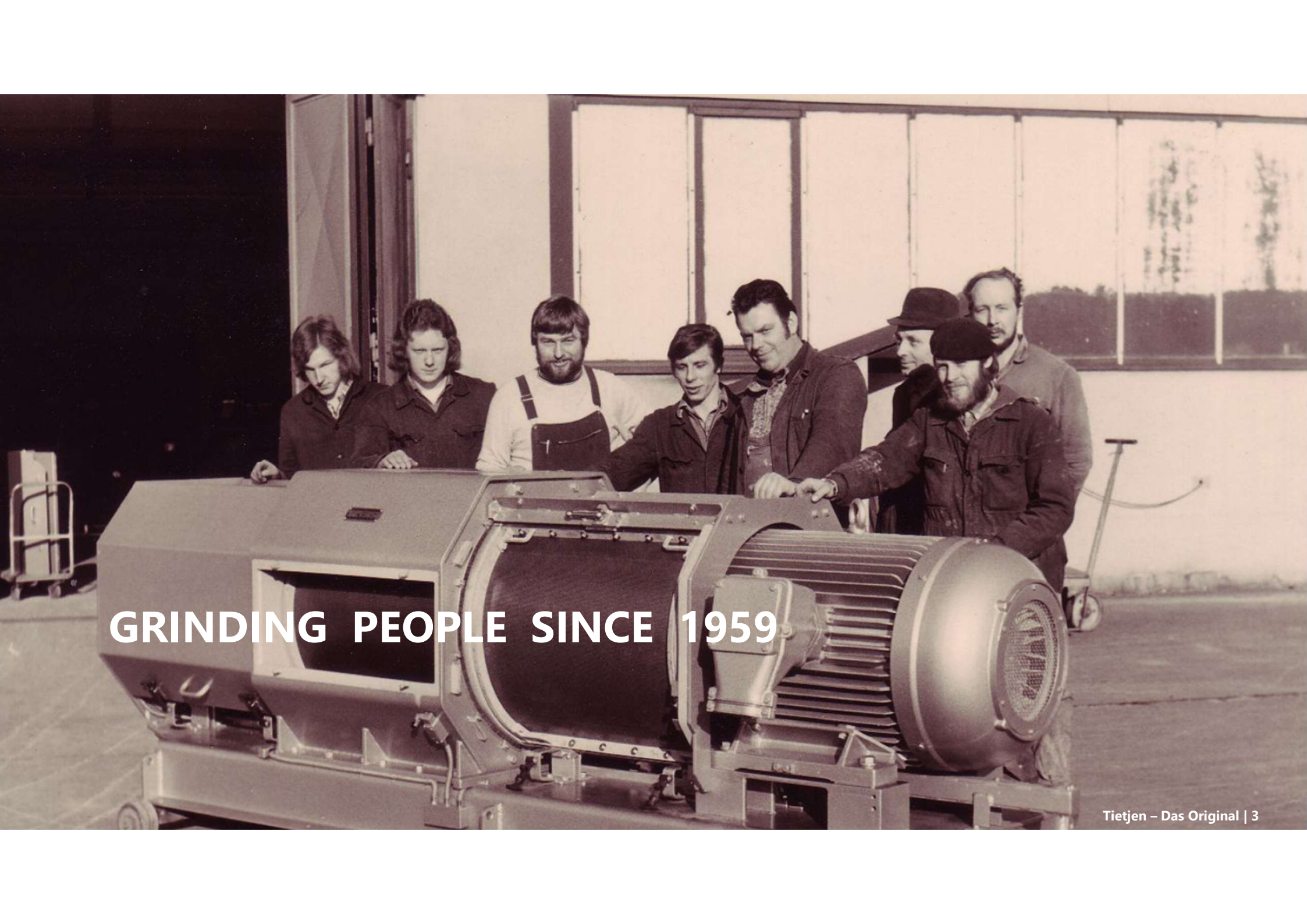
01. Intro

02. Efficiency: In Machine and Design

03. Efficiency: In Process and Automation

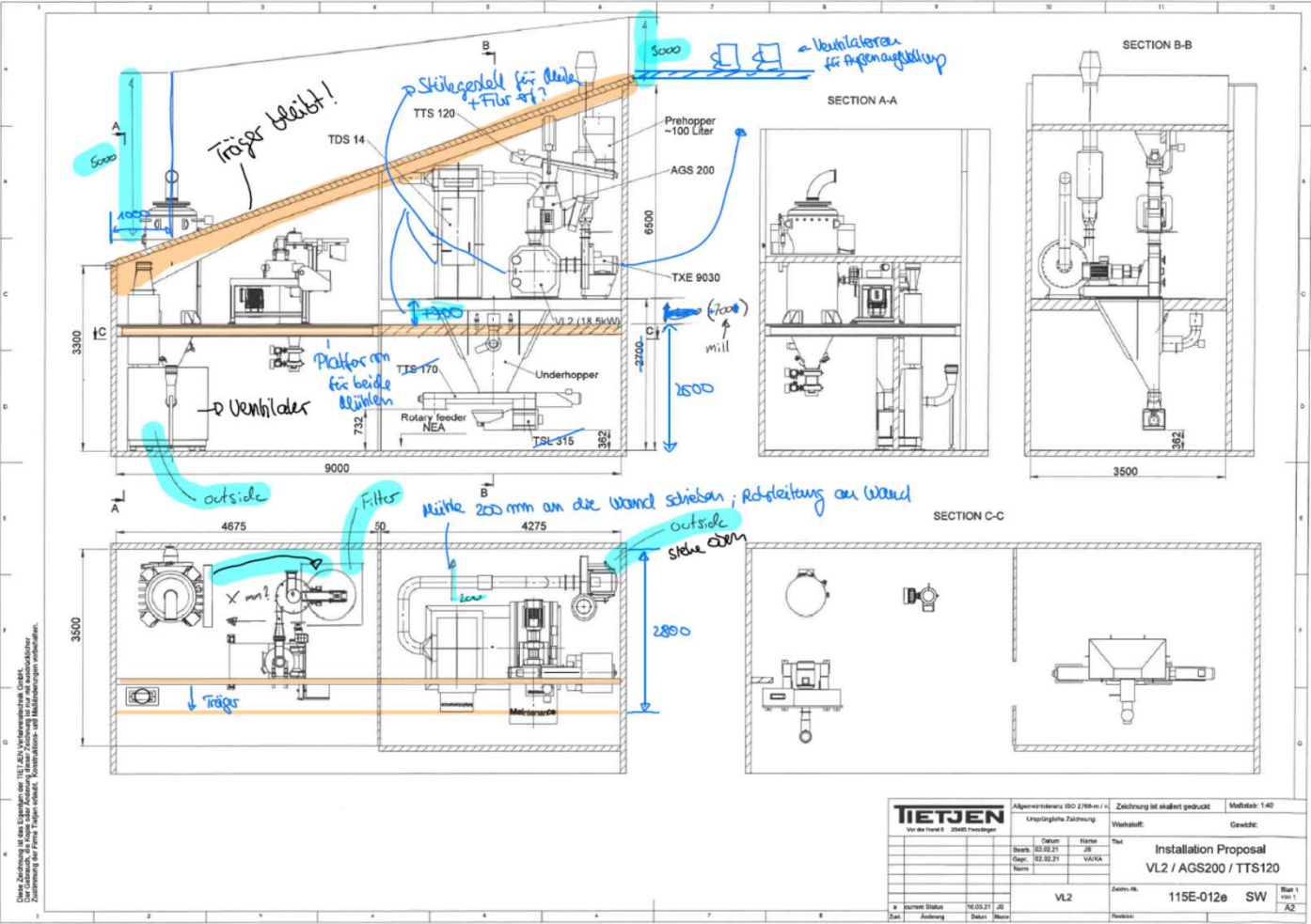
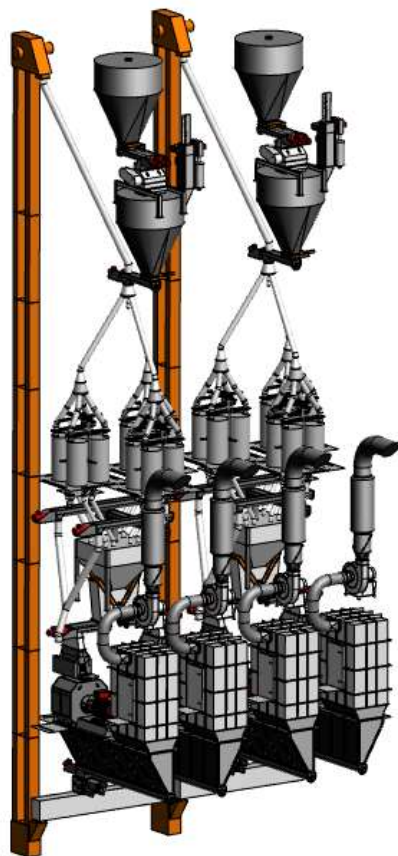


MADE IN GERMANY



GRINDING PEOPLE SINCE 1959

Complete Grinding Solutions / Plants



Grinding Plant in Sweden

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International Reach

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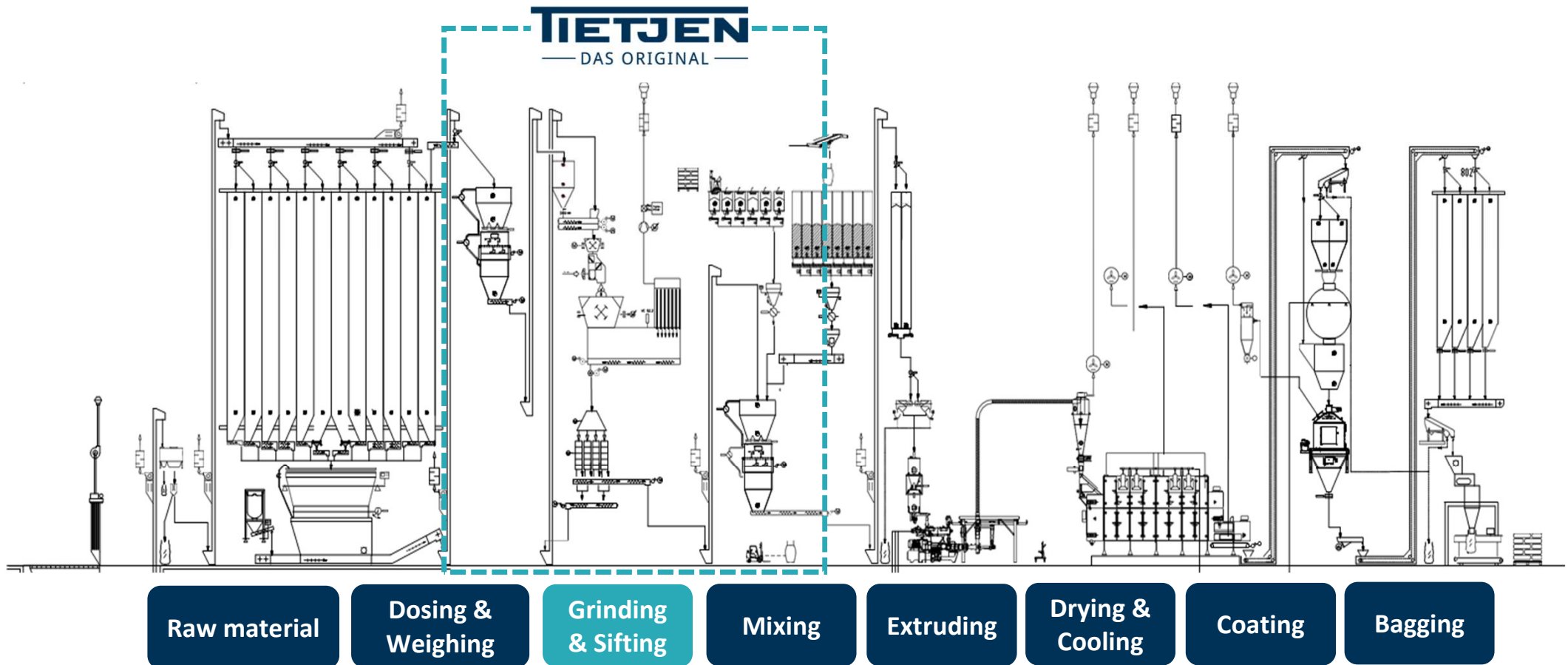


Grinding is the first step of making high quality pet food.



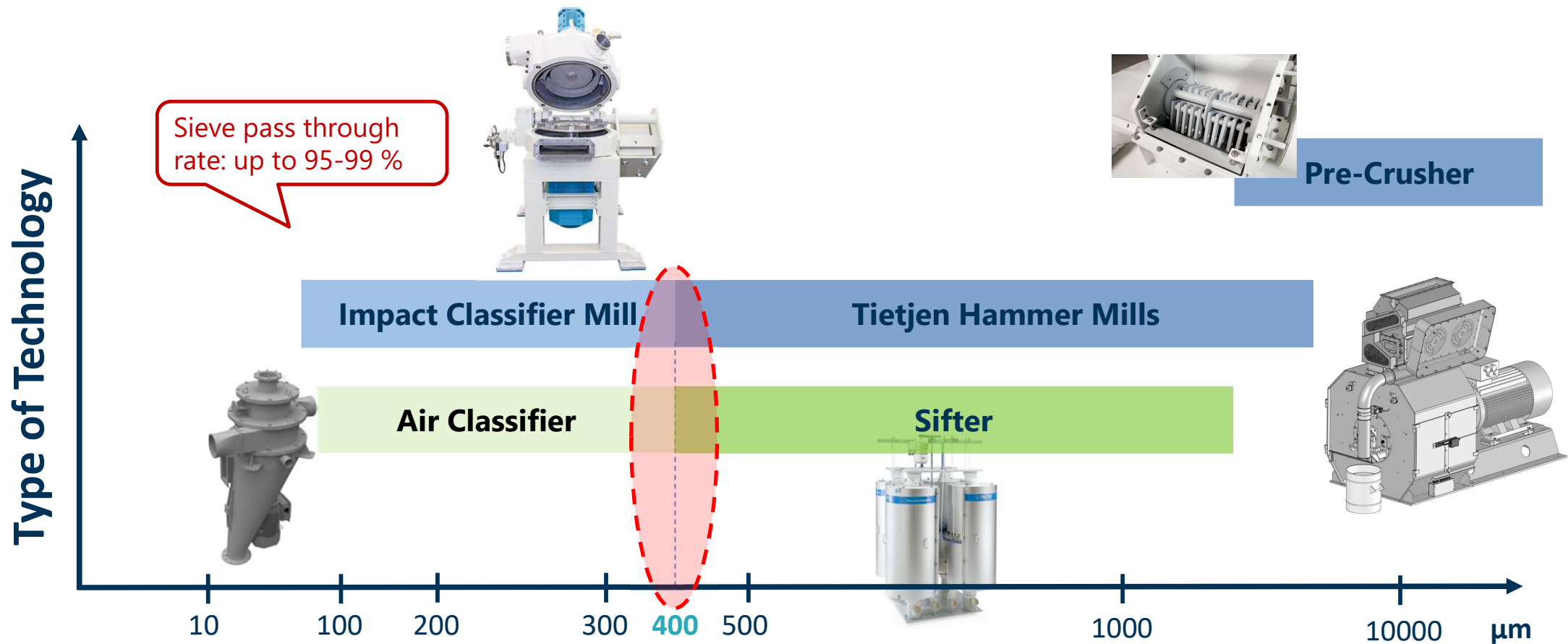
Tietjen Technology Focus

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Grinding Technologies by Tietjen

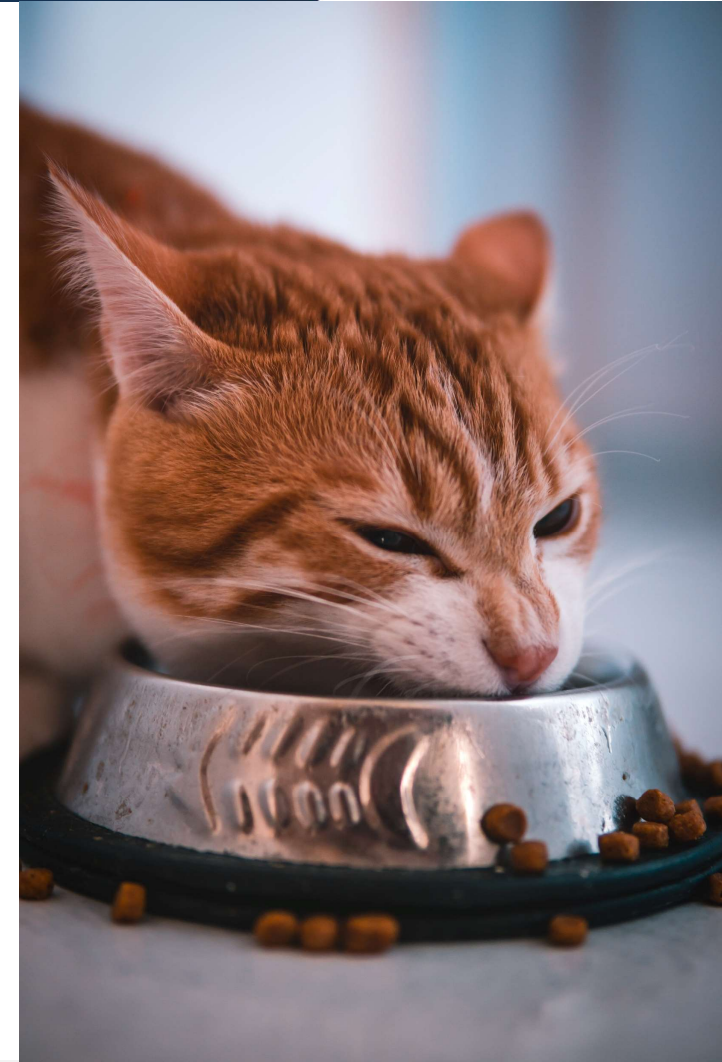
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The influence of grinding in petfood production

Improved Product Quality and Digestibility

- Improvement of the ingredient's nutritional properties
- Increasing surface area to enable or accelerate physical and chemical reactions
- Improving the appearance of the pellets, smooth surface



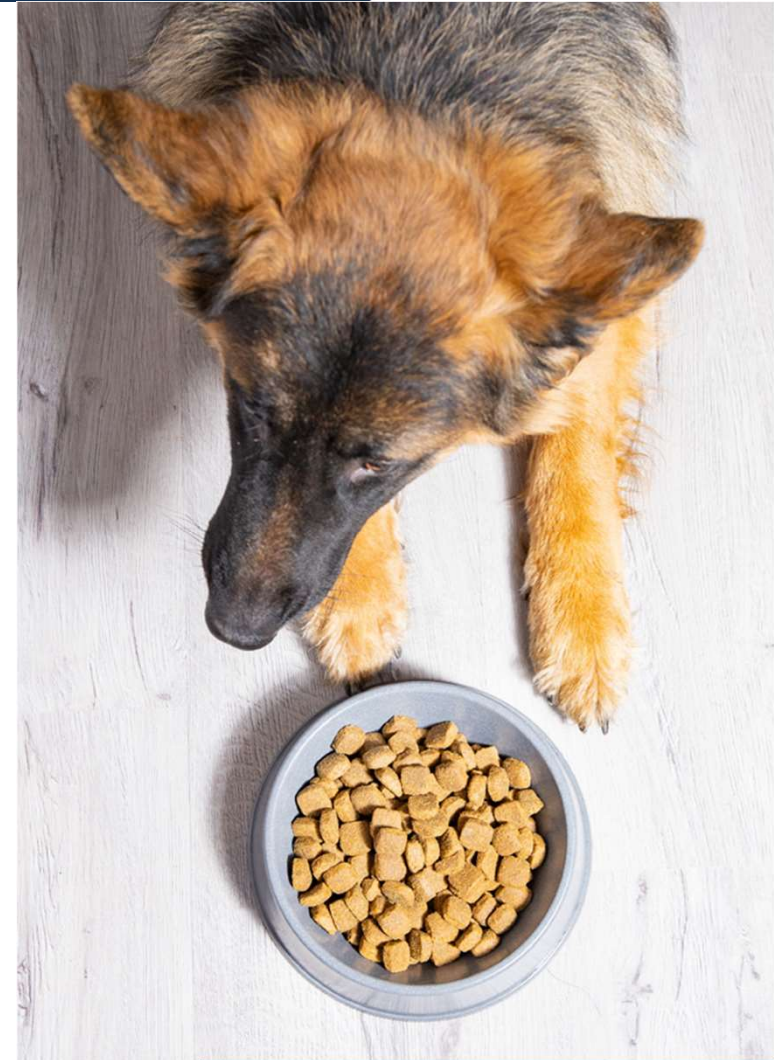
Requirements for grinding petfood recipes

Physical and production related

- High fineness
- Narrow grist spectrum
- Defined maximal particle size
- Low temperature increase

Recipe based challenges

- Fat level (> 8%)
- Protein level
- Higher meat & bone meal content (>30%)



Grinding of Petfood

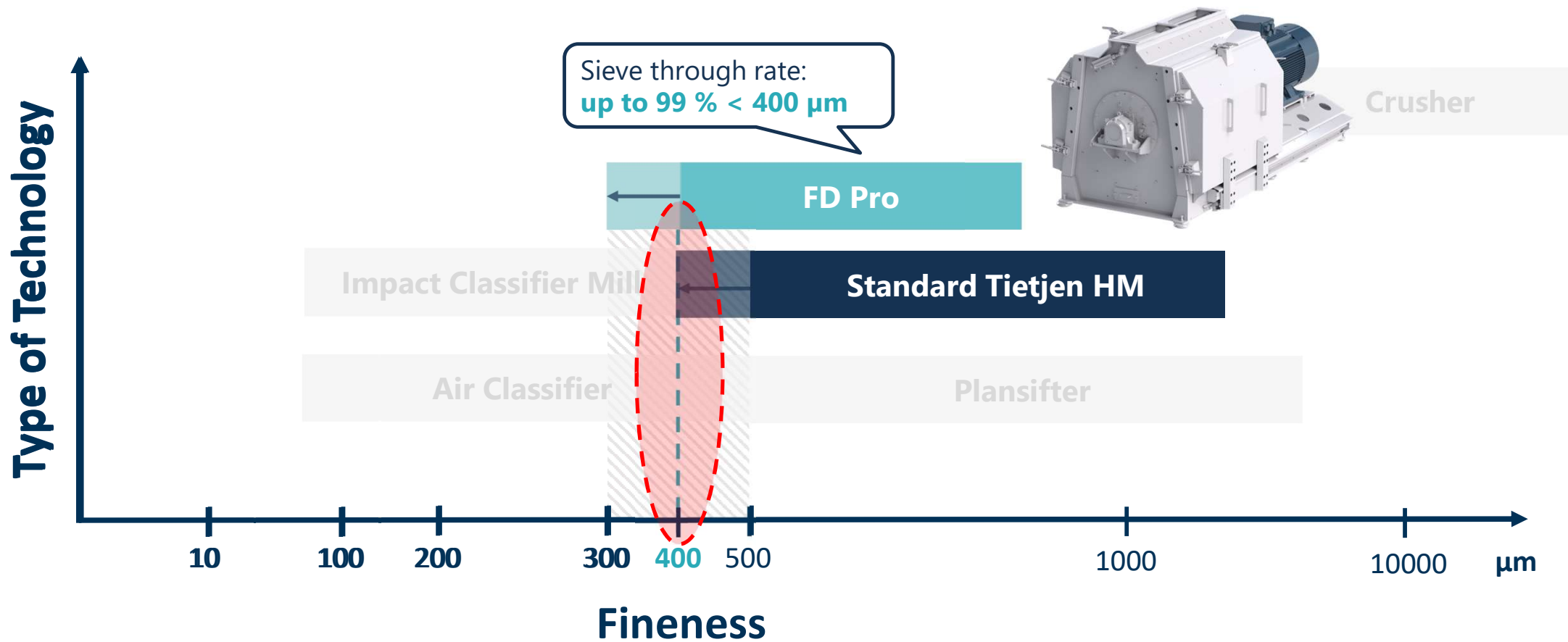
Challenges for the Hammer Mill

- Small screen diameters
- Thin screen thickness, mechanical damages
- Clogging of screens, especially with fatty and protein rich recipes
- Fluctuating grinding process
- Screen fastening and sealing, leakages of oversized particles
- Product heating up
- Undefined or wide grist spectrum
- **Energy consumption**



FD Hammer Mill designed for Fine Grinding

Sharp separation cut of the upper grist spectrum



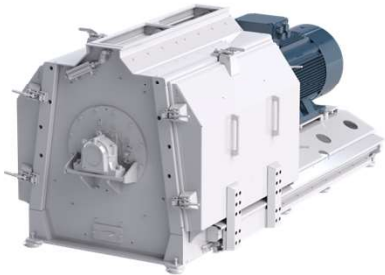
Petfood Hammer Mills

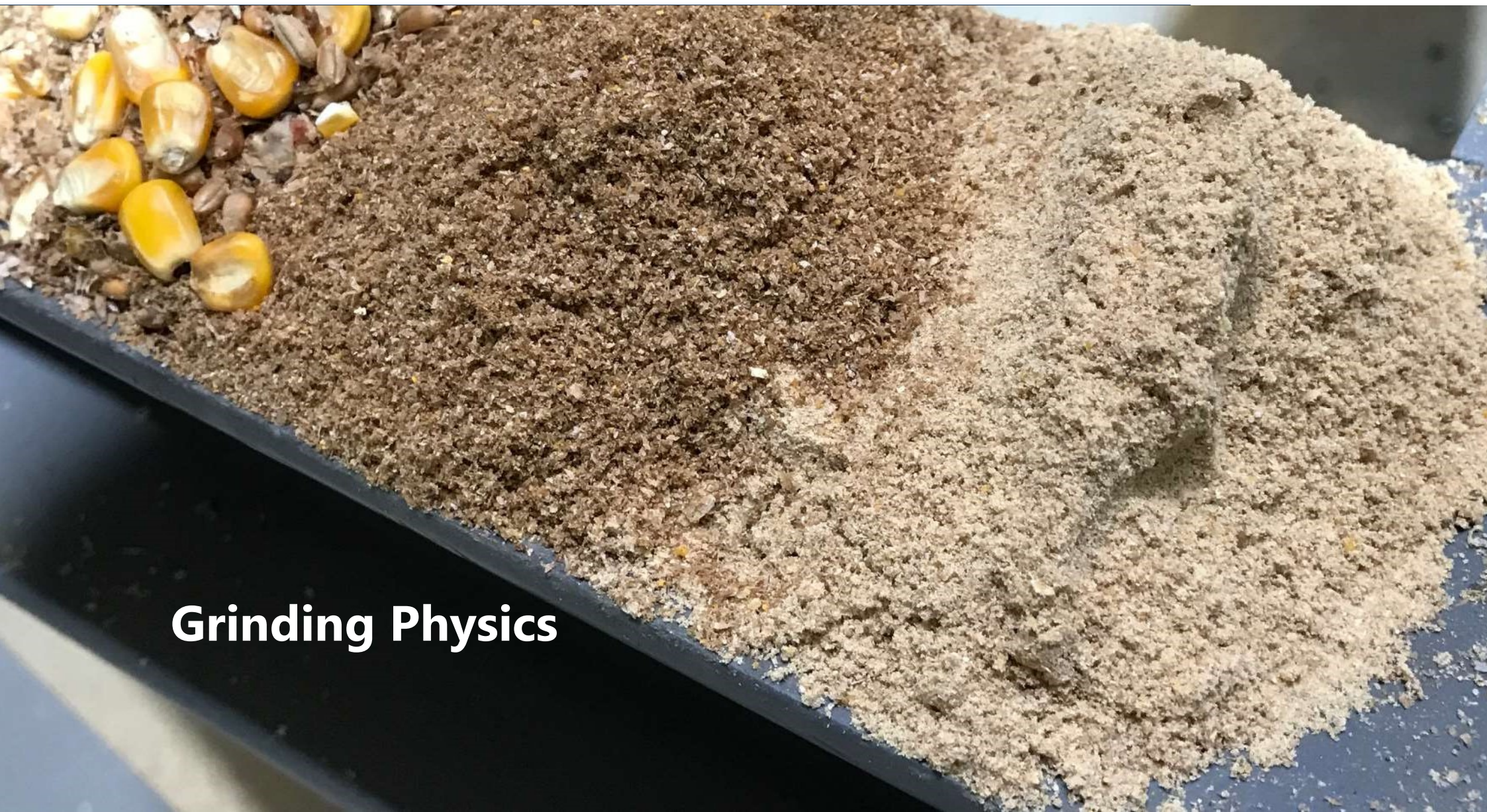
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Hammer Mill FD 32 Pro

0.8 mm screens in operation without clogging

> 15 t/hr in Premium Petfood



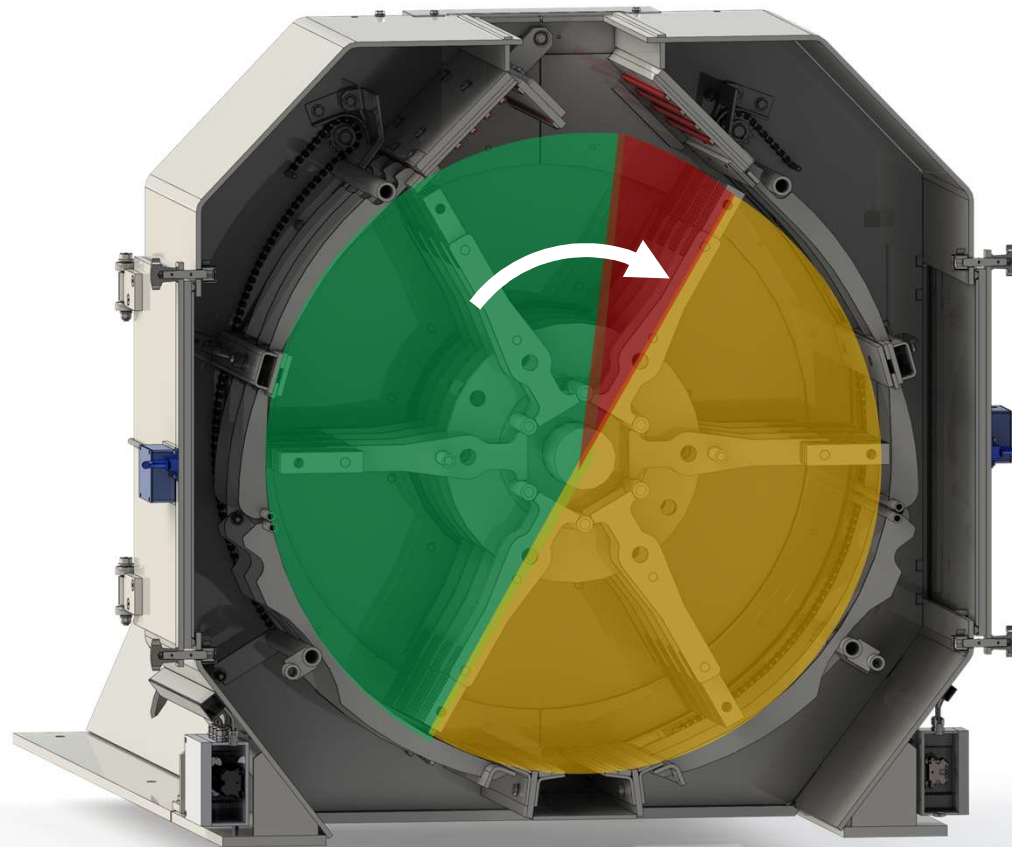


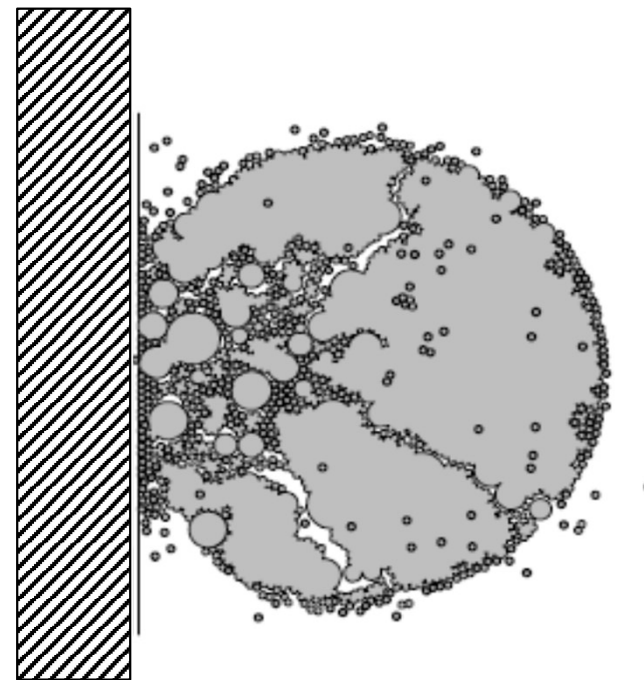
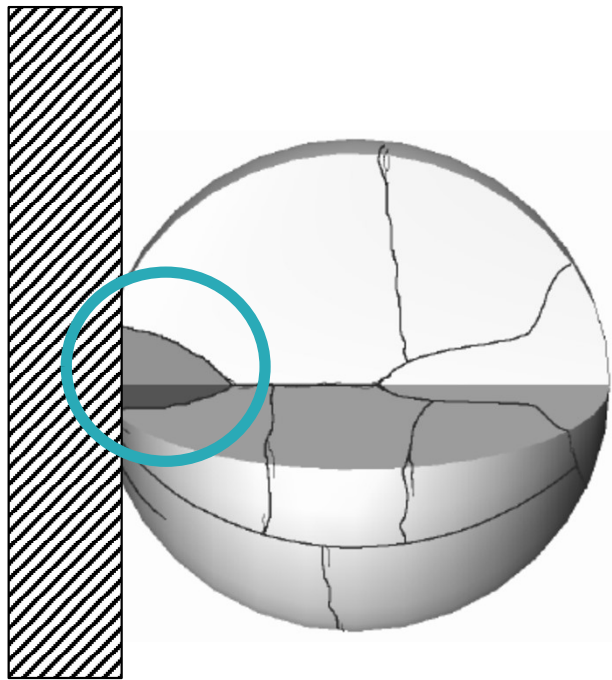
Grinding Physics

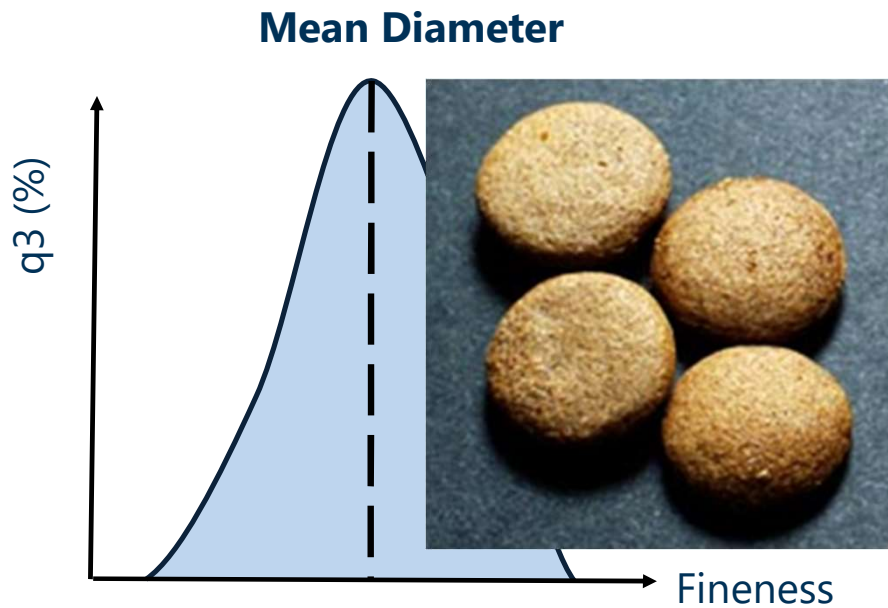
Grinding Process inside a Hammer Mill

Hammer Mill Fine Grinding

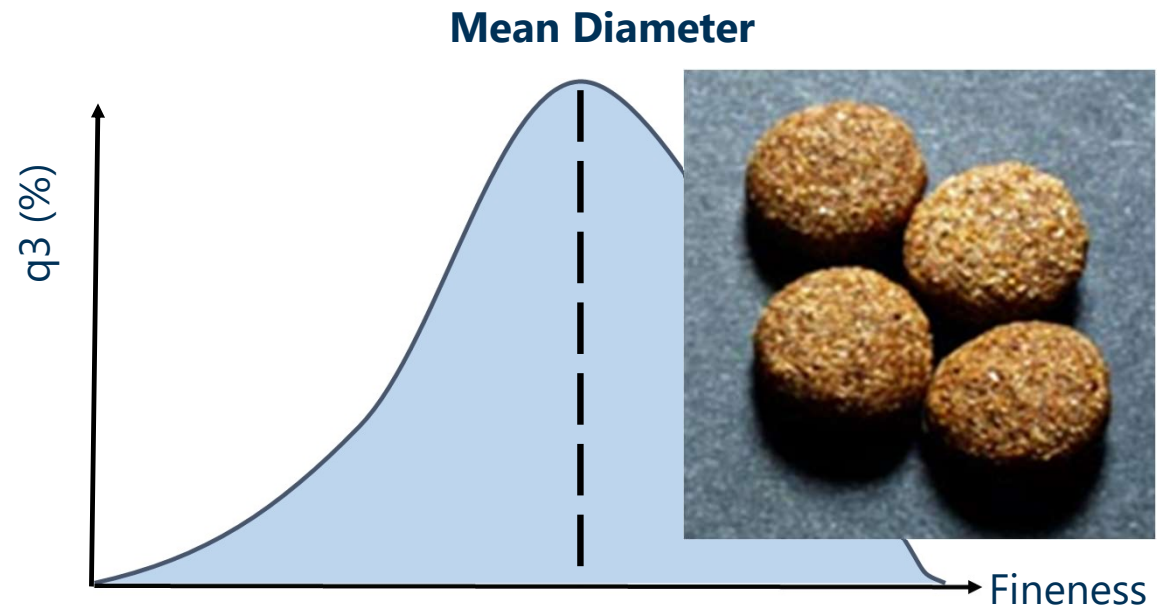
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- narrow grist spectrum



- wide grist spectrum

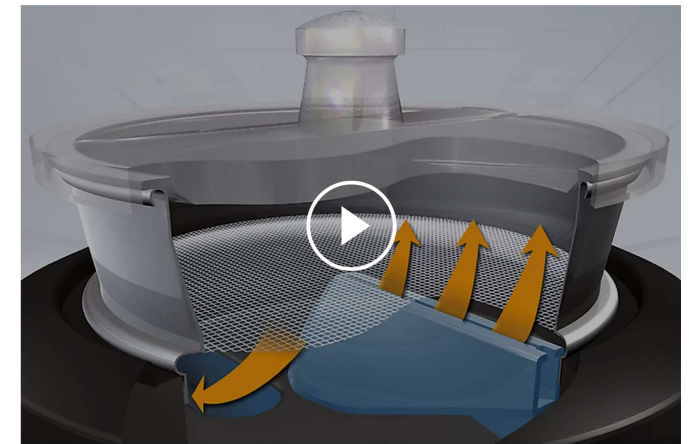


How to measure

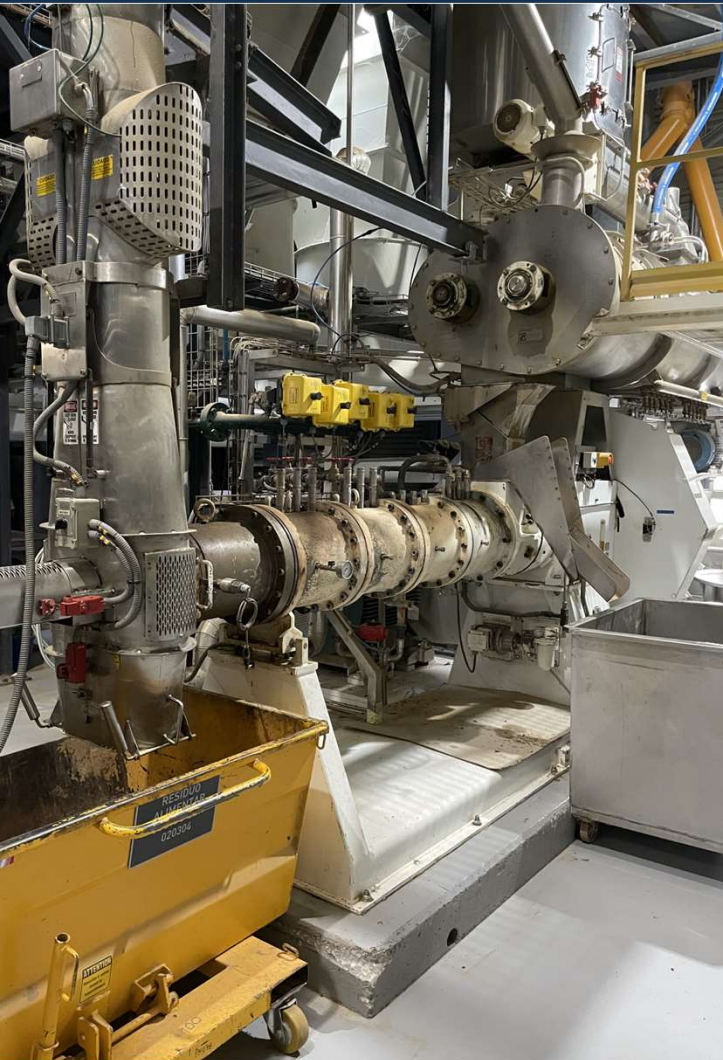
Air Jet Sieve for analysing ground petfood:

<https://www.retsch.com/products/sieving/sieve-shakers/as-200-jet/>

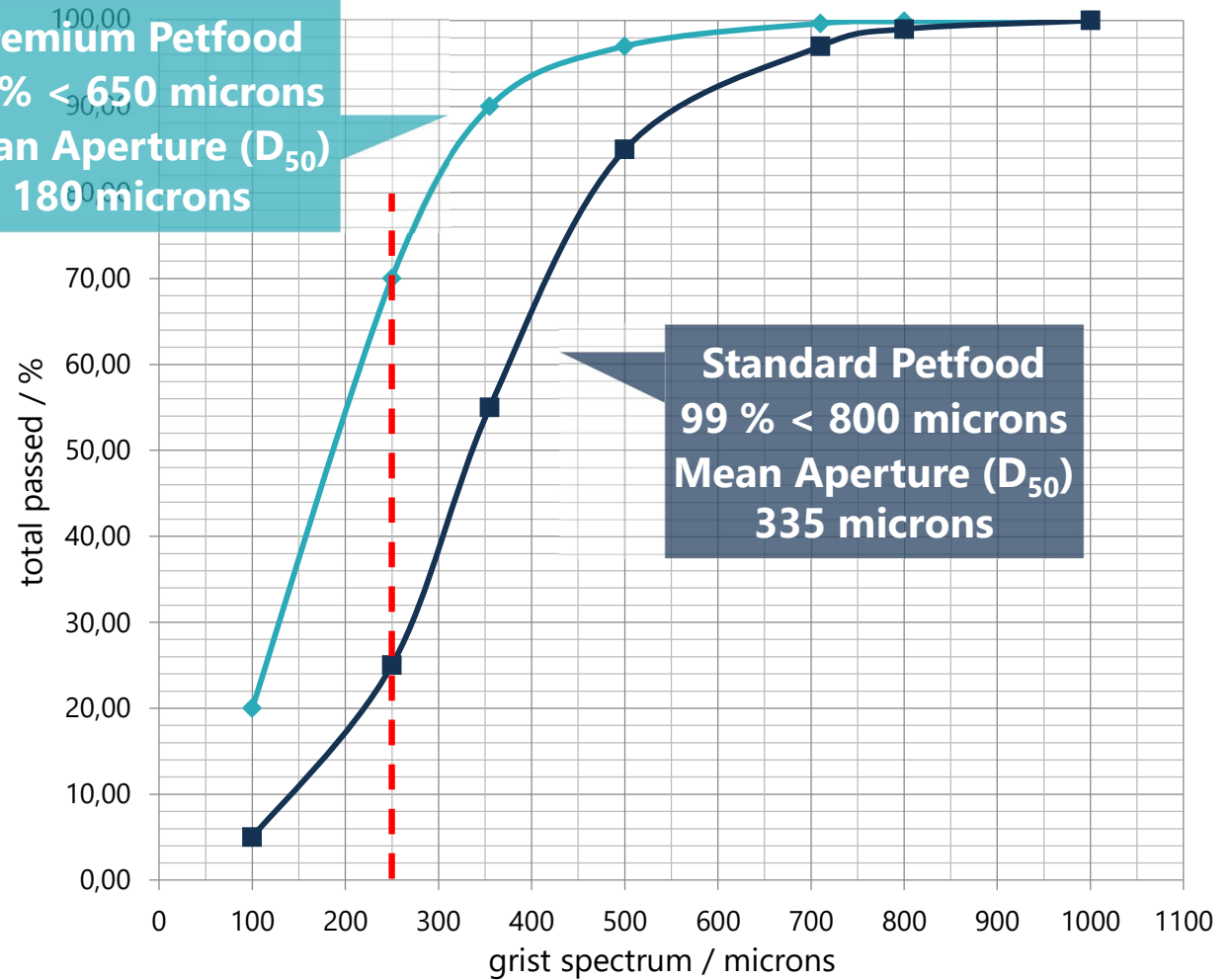
- Traditional hand shakers show problems with fatty/sticky and clogging particles
- Result: Grist spectrum is finer in reality than presented in the analysis
- Air jet sieve cleans the meshes and also deagglomerates the particles much better



Particle Size Distribution



Premium Petfood
99 % < 650 microns
Mean Aperture (D_{50})
180 microns



Standard Petfood
99 % < 800 microns
Mean Aperture (D_{50})
335 microns

FINE GRIND...

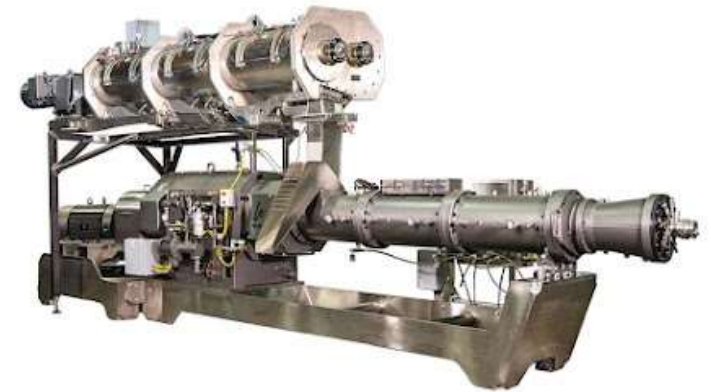
- eases steam and liquid acceptance
- improves reactivity through enlargement of surface area
- can support capacity

BUT:

- Risk of backflow in the barrel – capacity decrease
- Risk of reactivity / cook too early in the barrel or even in the grinder – quality and process deficiencies

THEREFORE:

- Shear and conveying in the extruder barrel must be effective and within defined limits
- Cooking preferably in the end of the extruder barrel – optimized extruder set-up
- Twin extruders tend to better answer to the challenges, but also single with high shear and conveying can also manage the challenge
- Control of wear and pro-active maintenance



01. Intro

02. Efficiency: In Machine and Design

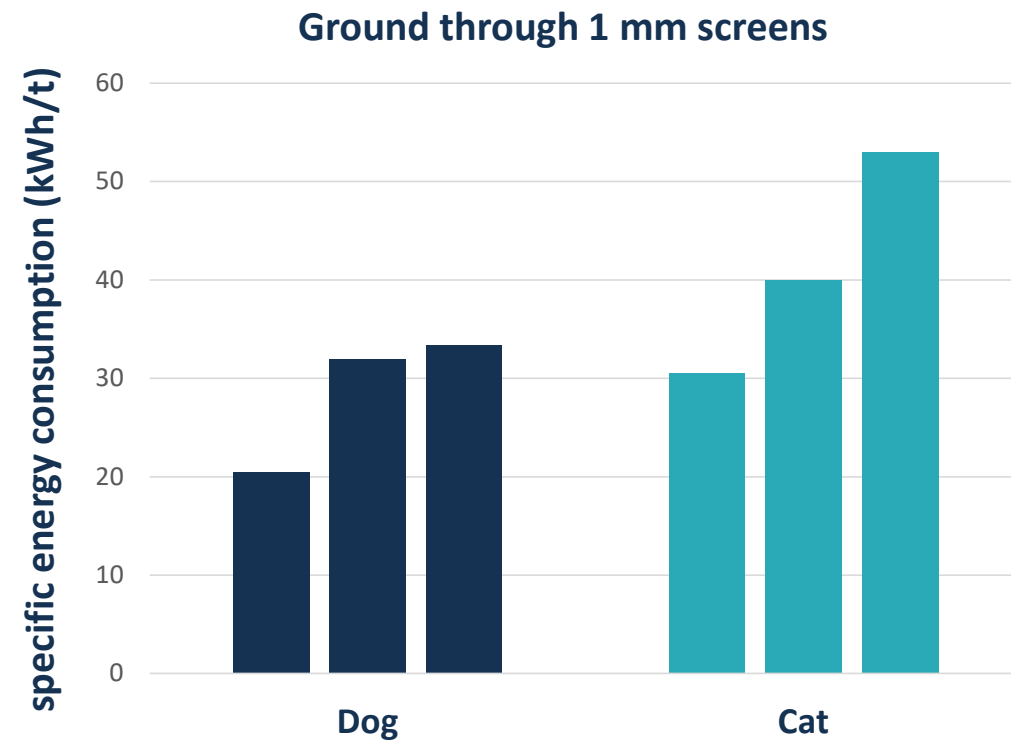
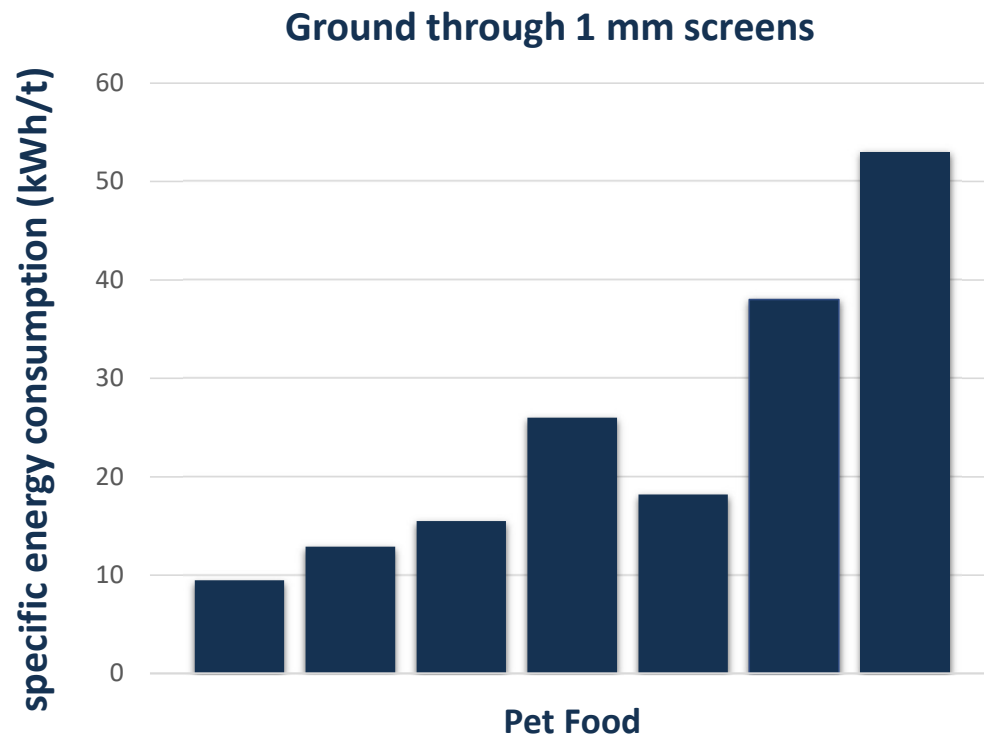
03. Efficiency: In Process and Automation



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Energy Consumption for different Recipes

Some case studies...



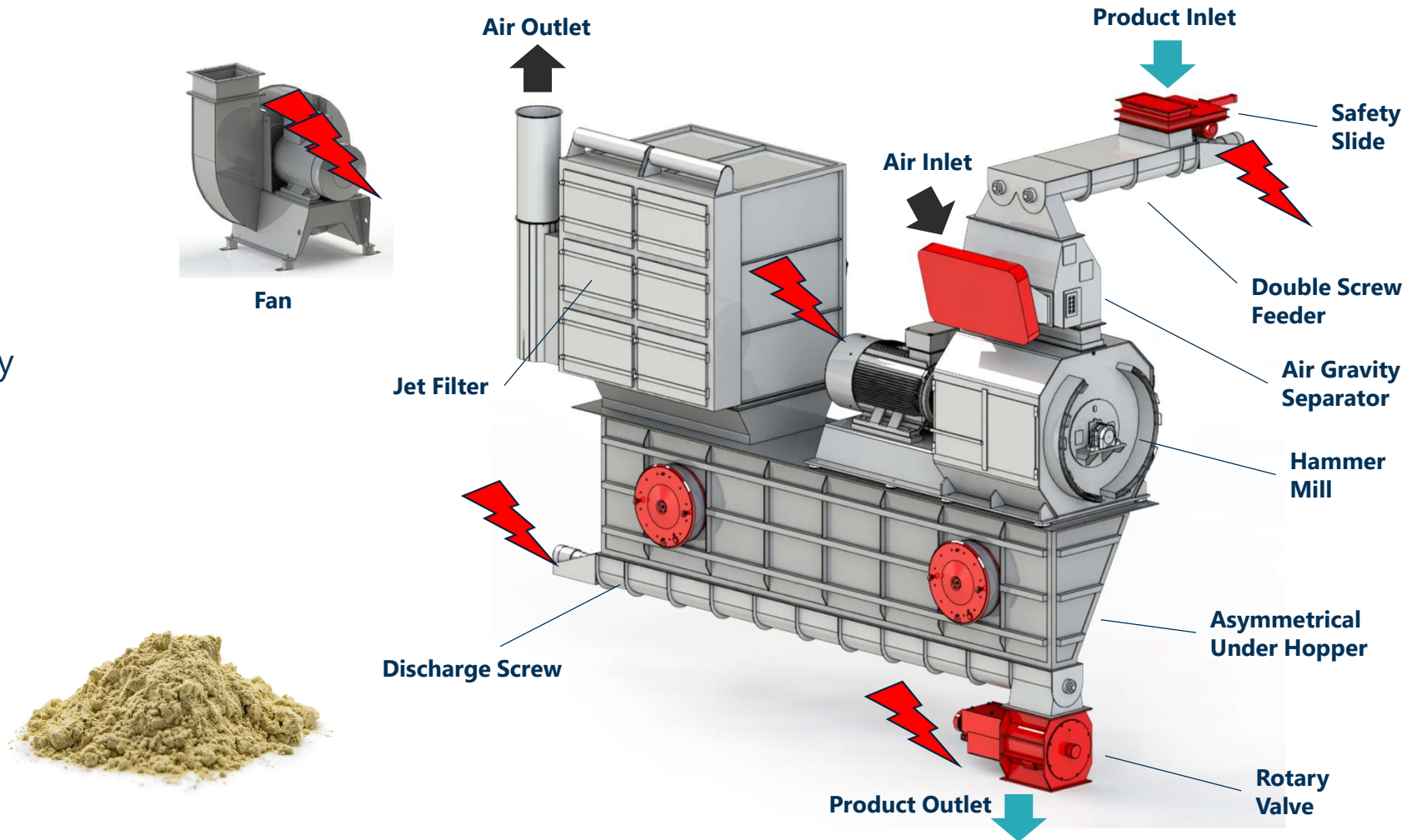
Dry Milling Energy Balance

Input

- Raw product
- Aspiration air
- Electrical energy

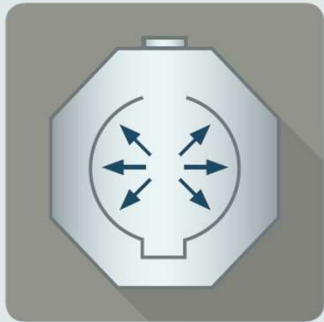
Output

- Meal (warm)
- Air (warm)

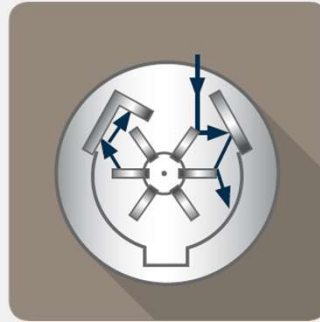


Grinding Physics - Influencing Factors

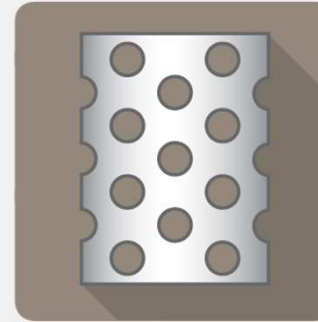
Hammer Mill Design and Configuration



Hammer Mill Load or
Screen Area



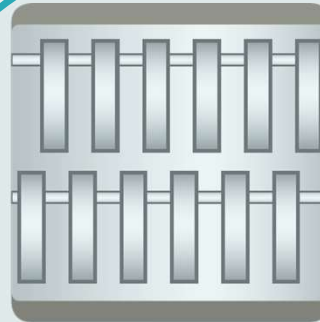
Grinding Chamber
Design



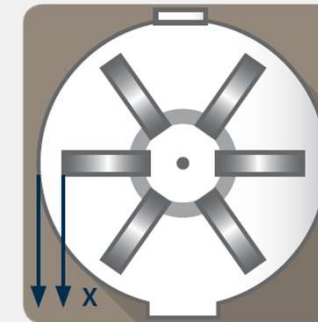
Screen
Diameter/Perforation



Beater Tip Speed

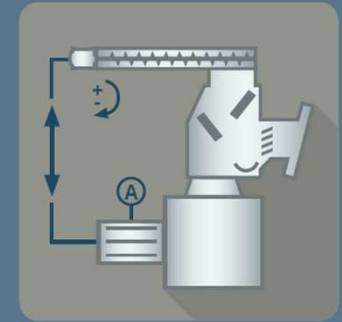


Beater Configuration
Wiping Area

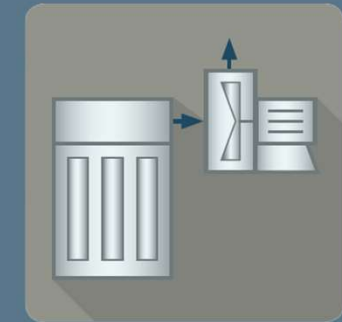


Distance Beater - Screen

Grinding System

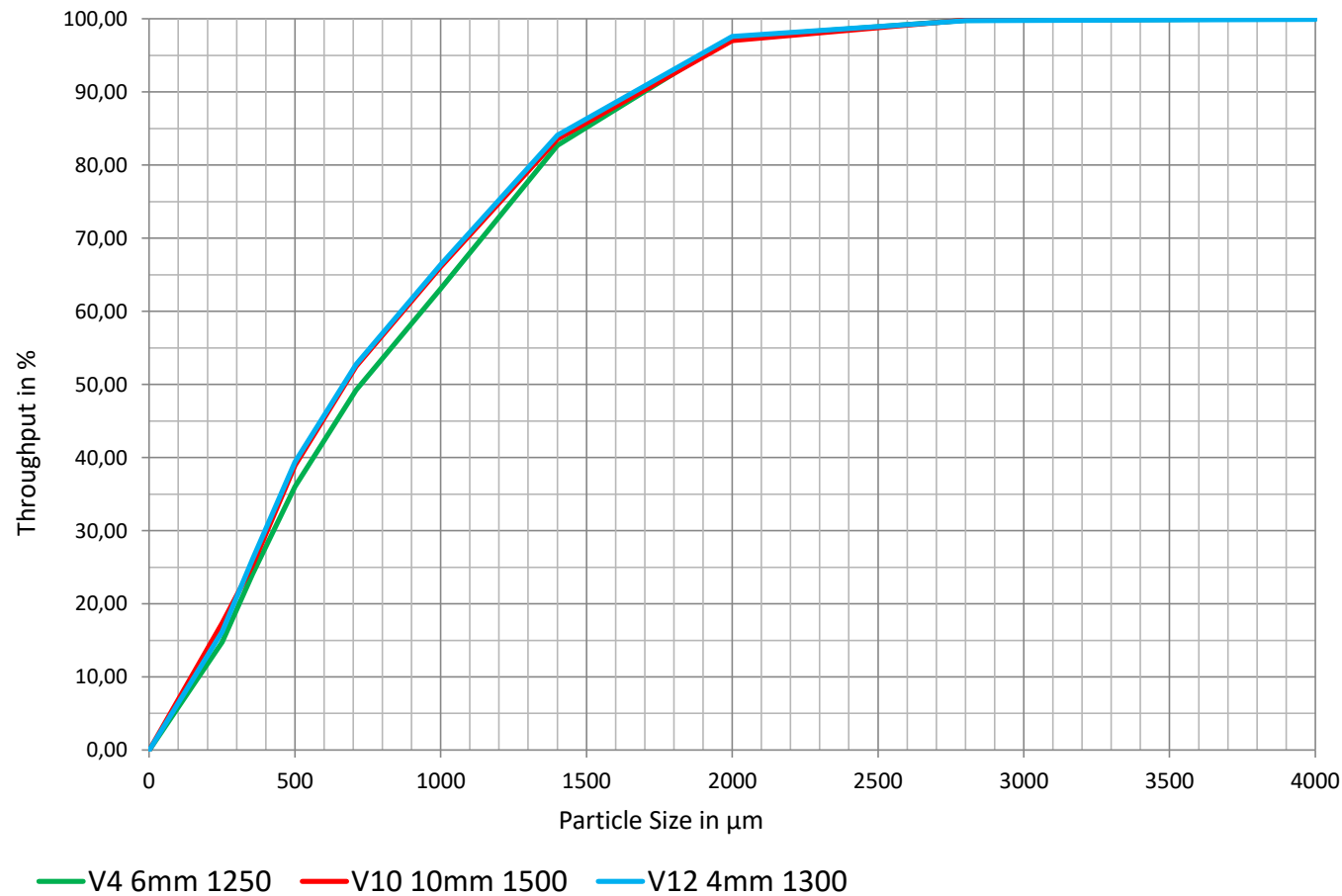


Feed System

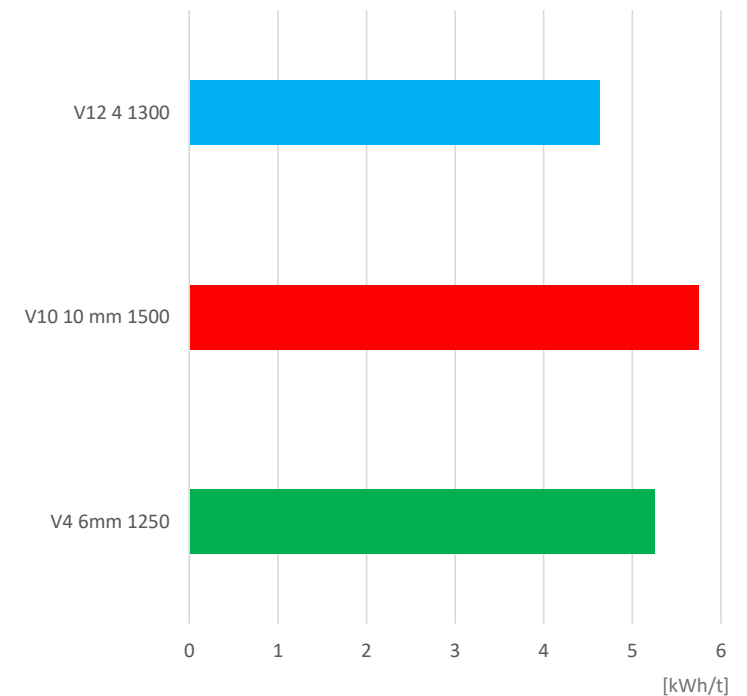


Aspiration System

Energy Impact of different Beaters



Specific Energy Consumption



Energy Impact of different Beaters

Configuration 1

3 axis (1-2-3)
10 mm beater

Rotation
1,500 rpm

Tip Speed
92,4 m/s

Specific Energy Consumption
5.75 kWh/t

+22,500 CAD

Additional costs for grinding *

Configuration 2

6 axis (3-3)
4 mm beaters

Rotation
1,300 rpm

Tip Speed
80,1 m/s

Specific Energy Consumption
4,625 kWh/t

Basis

Configuration 3

6 axis (3-3)
6 mm beaters

Rotation
1,250 rpm

Tip Speed
77,0 m/s

Specific Energy Consumption
5,25 kWh/t

+12,500 CAD

Additional costs for grinding *

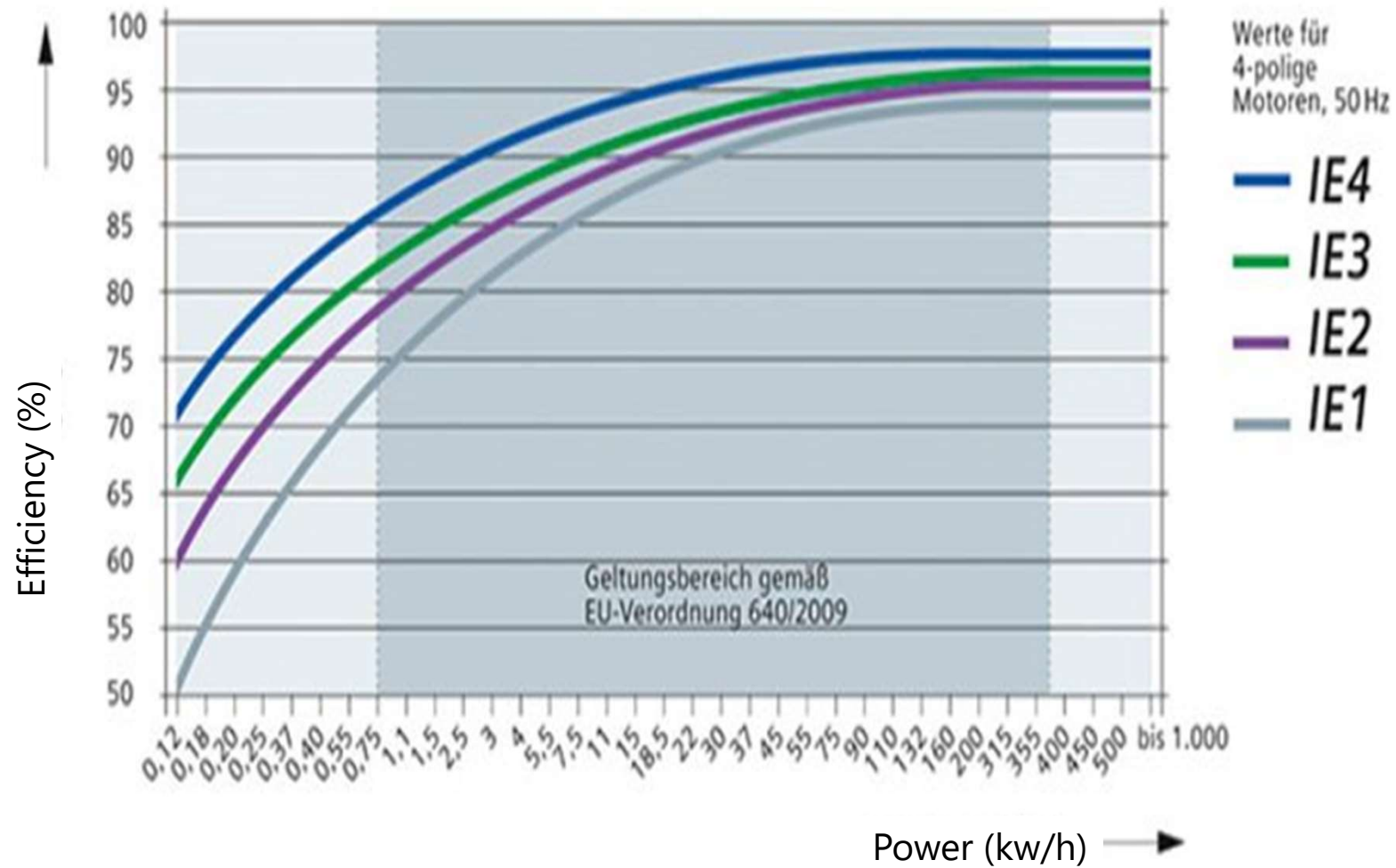
* Assuming 200,000 tons of production per year and an average price of 10 ct per kWh

Energy Consumption (Mill 50 t/hr)

Source	Consumption	%
Drive Dosing	1,5 kW	0,4
Mill Motor	355 kW	92
Discharge Screw	5,5 kW + 1,5 kW	1,7
Drive Fan	22 kW	5,9
Total	385,5 kW	100%

Energy Efficiency

4-pole main motors



Example:

- Motor: 400kW, 400V-50 Hz, 4-pole Motor, ATEX rated, VSD suitable
- Operation: 20h/d and 350d/y
- Price IE3 € 16,900 EUR (Efficiency ~96%)
- Price IE4 € 22,790 EUR (Efficiency ~97%)

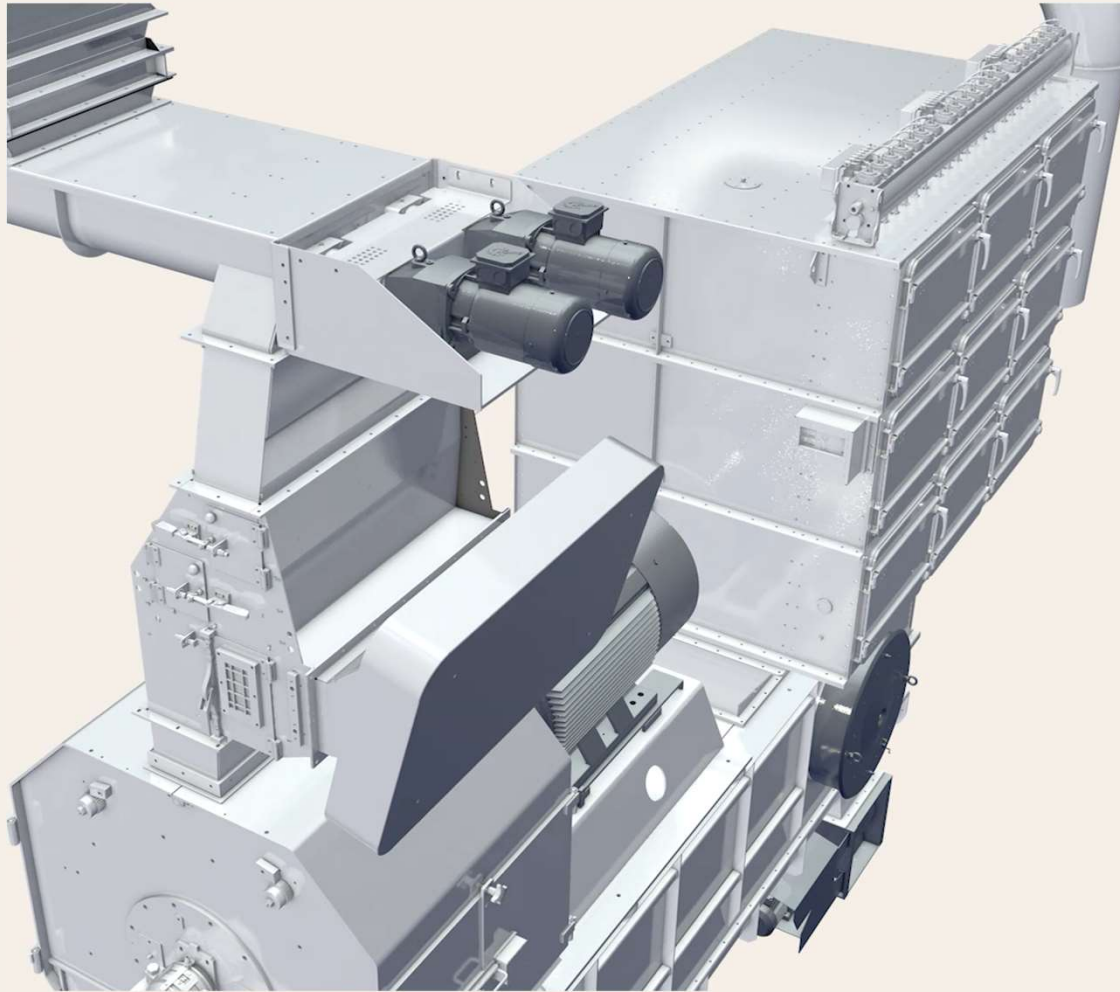
Question: 5,890 EUR difference in price to receive ~1% better efficiency?

Savings and Payback:

- 4 kW/h ~0,40ct/h (0.10ct/kwh)
- Pay back period: $\text{€}5,890 \text{ EUR} / 0.40\text{ct/h} = 14,725\text{h} = \sim 736\text{d} = \sim \mathbf{2,1\text{years}}$

Controlling the Millmotor

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Correct Aspiration

- Perfect product transport through hammer mill
- Cooling effect of product
- Cleaning of product
- Transport of product to total- separator / filter

Insufficient Aspiration

- Reduced throughput
- Heating up of product
- More fine particles in meal
- Higher wear
- **Higher energy consumption**

Aspiration Flow in a HM

Savings due to air-tight Grinding System

Sealed Grinding Chamber

Before sealing

Grinding time per batch
05:31 min

Vac P
- 10.8 mbar

After sealing

Grinding time per batch
04:11 min

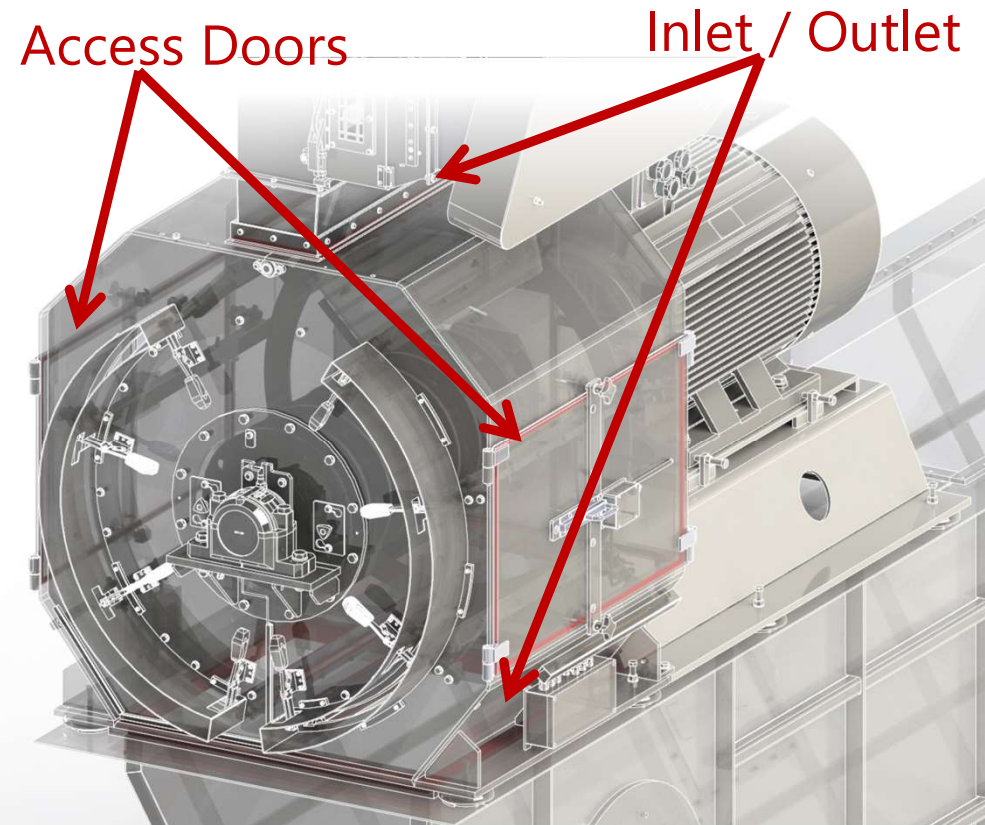
Vac P
-13.9 mbar

24.2 %

Less grinding time / more capacity

\$ 29,000

CAD p.a. savings
assuming 300 kW main drive, 4.000 production hours, 10 ct/kWh



Agenda

01. Intro

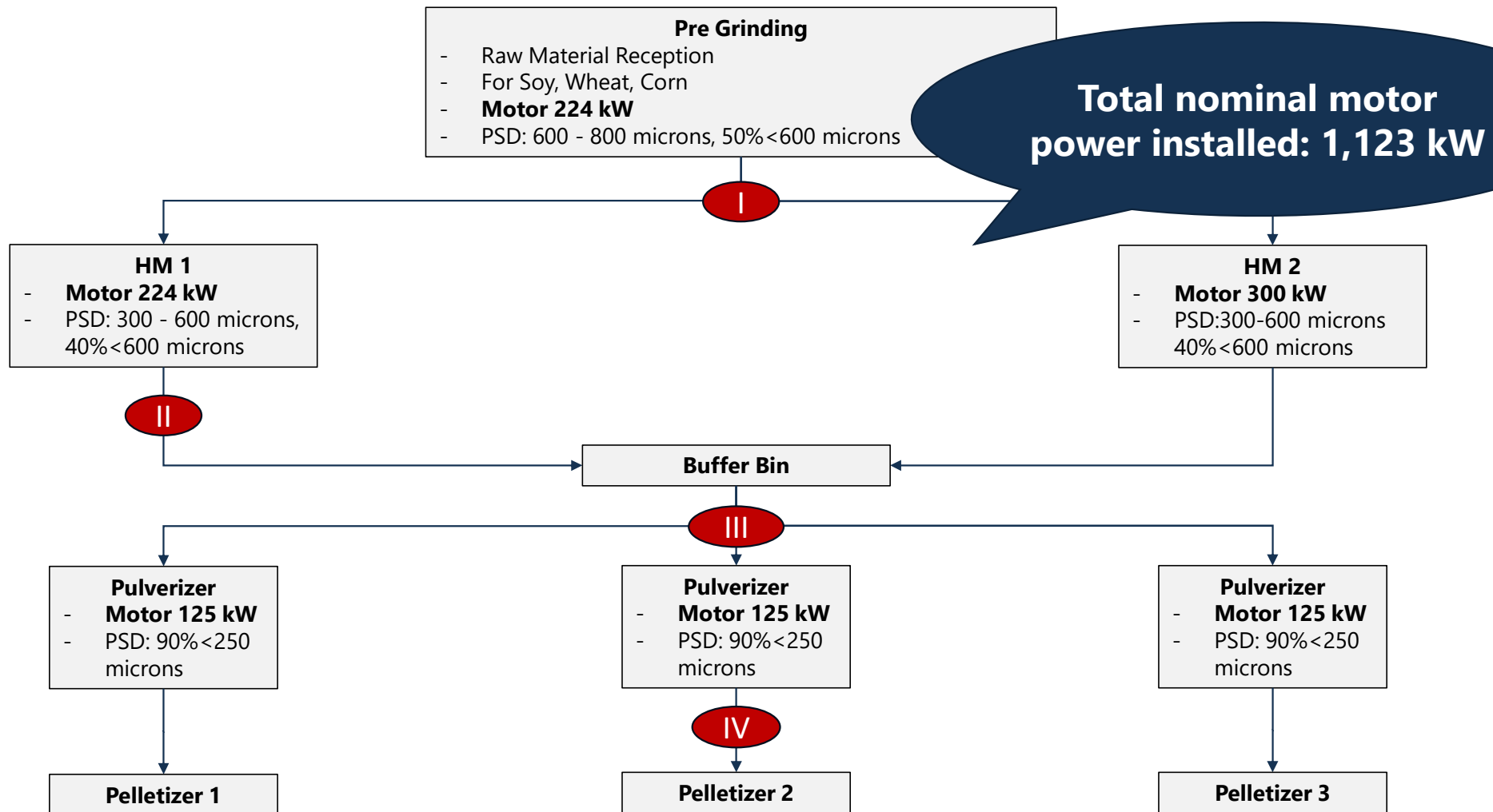
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In Machine and Design

03. Efficiency:
In Process and Automation

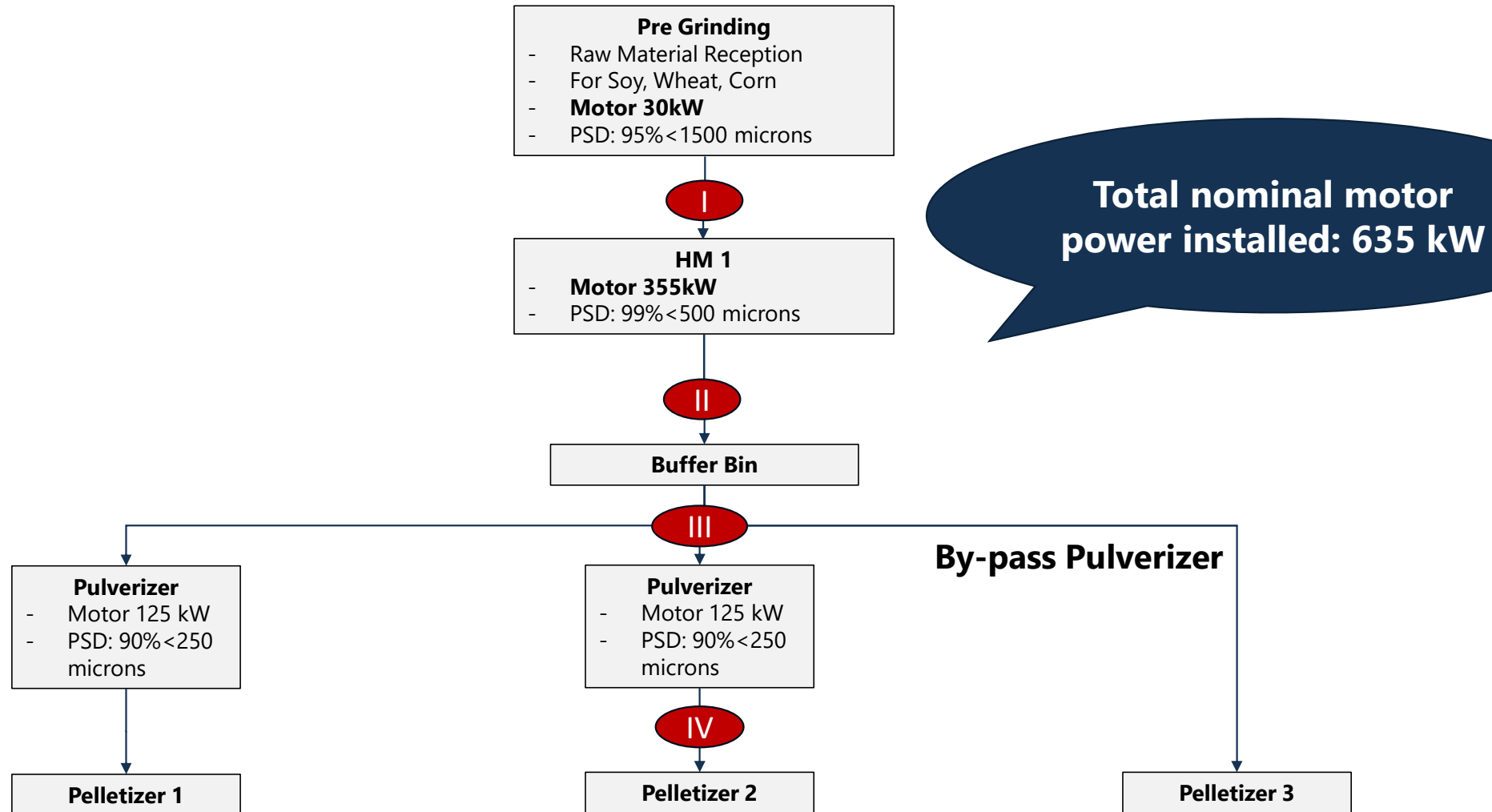


MADE IN GERMANY

Process and Energy Efficiency - Analysis

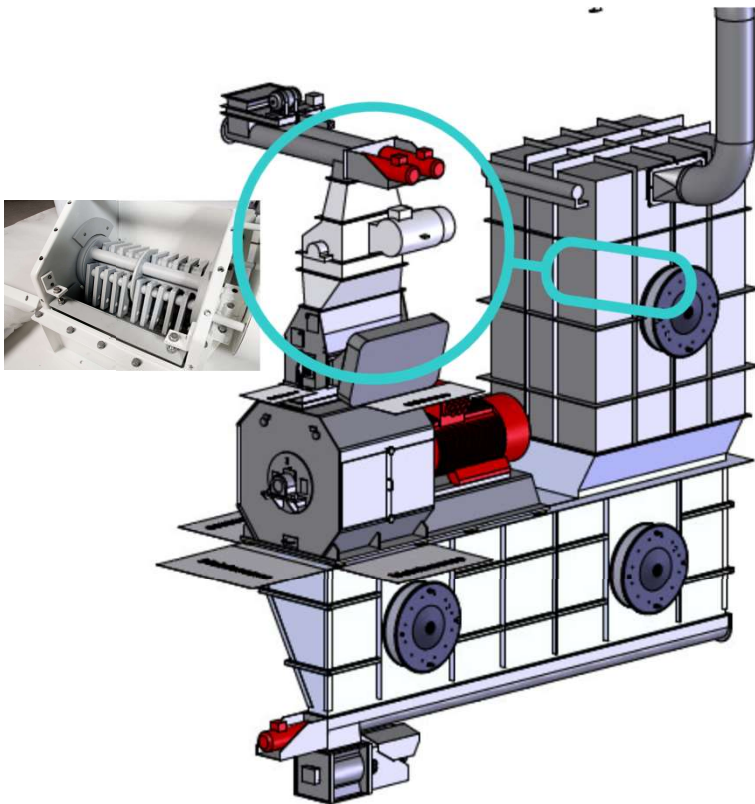


Process and Energy Efficiency - Recommondation



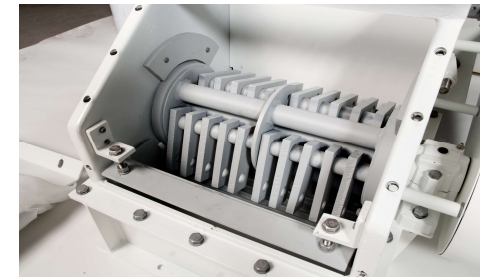
Integrated Pre-Crusher

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Main **Advantages:**

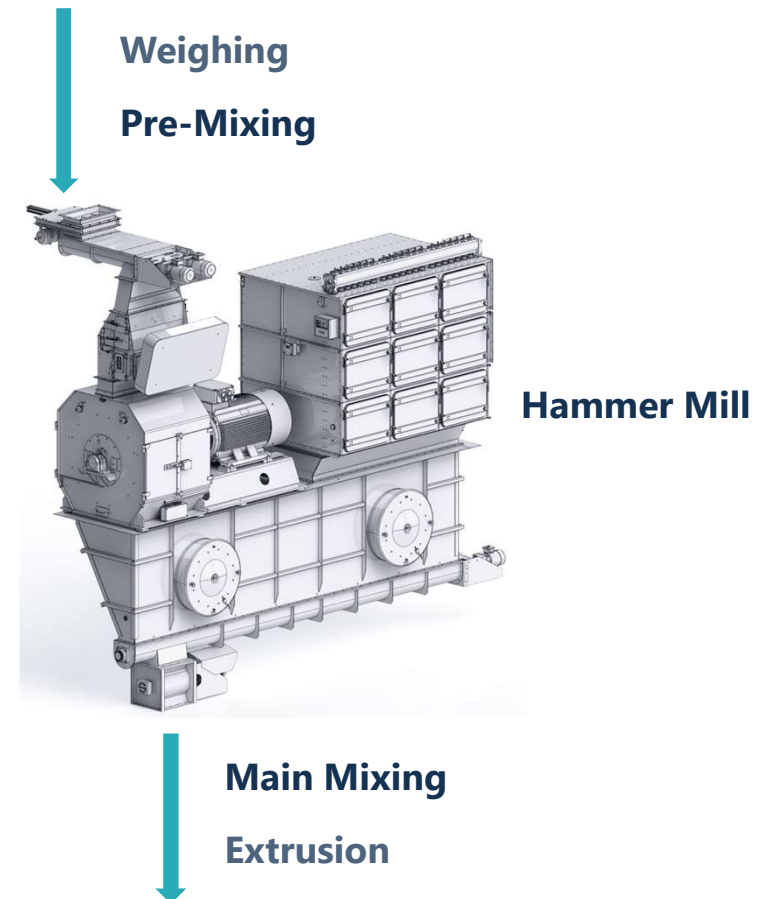
- Pre-crushing of pulses and pellets before fine grinding hammer mill
- Protection and improved availability of the fine grinding system
- Only limited aspiration necessary
- **Energy consumption approx. 1 kW/ton / Energy saving in HM due to raw material homogenization**



Grinding Concepts

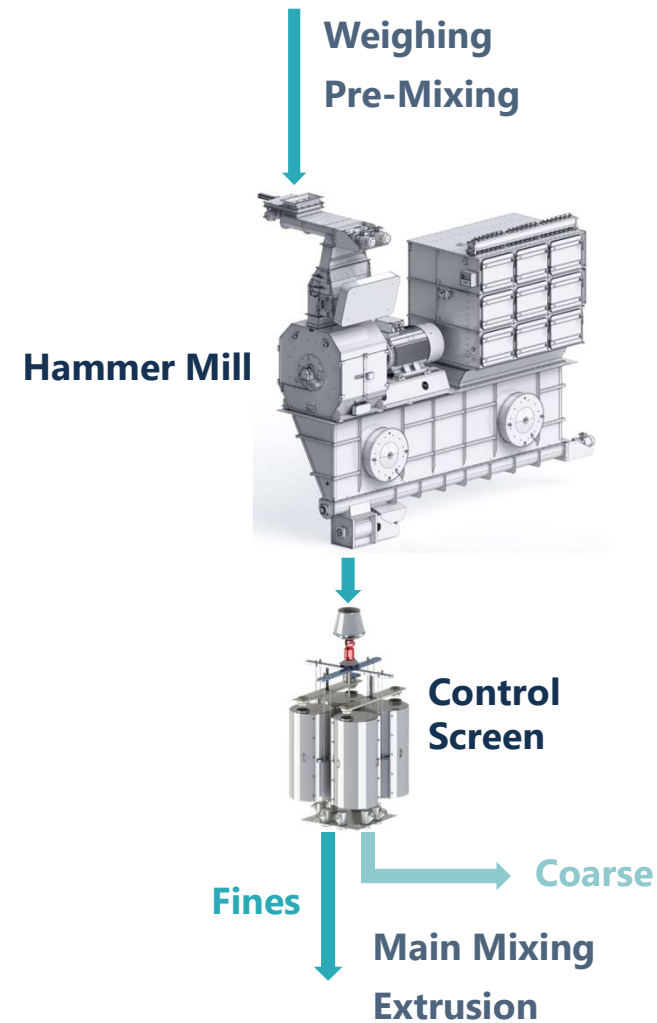
Direct Grinding

- ✓ Simple plant design, small footprint
 - ✓ Less investment costs
 - ✓ Less maintenance
- **No protection of buffer silo or extruder in case of screen damage in hammer mill**



Control Screening

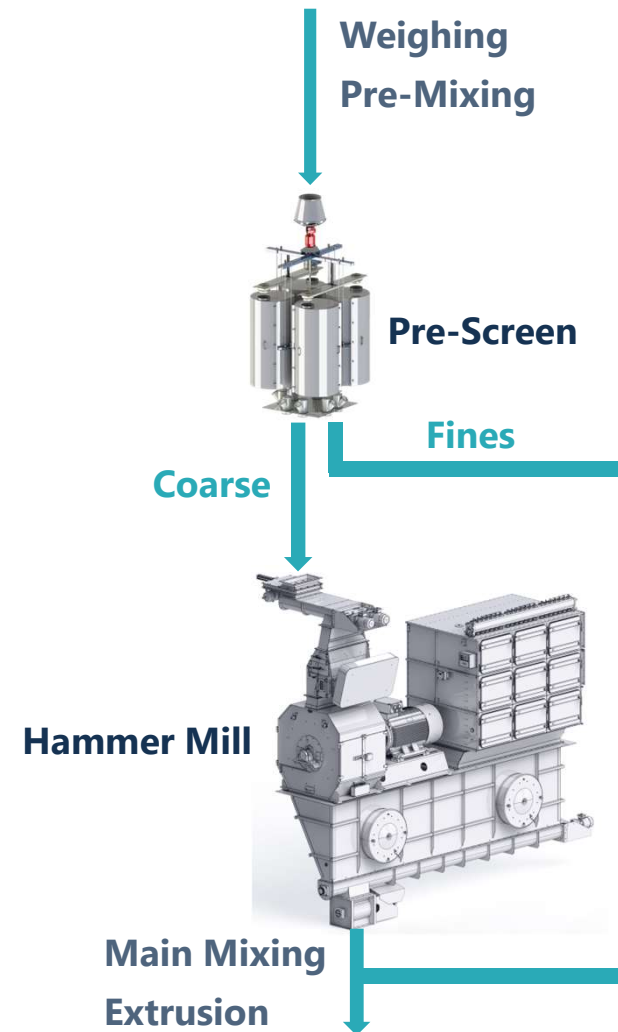
- ✓ **Protection of buffer silo or extruder in case of screen damage in hammer mill**
- Higher footprint
- Higher investment costs
- More maintenance



Grinding Concepts

Pre-Screening

- ✓ **Energy savings, no grinding of fines**
- Higher footprint
- Higher investment costs
- More maintenance
- **Coarser grist spectrum**
- **No protection of buffer silo or extruder in case of screen damage in hammer mill**

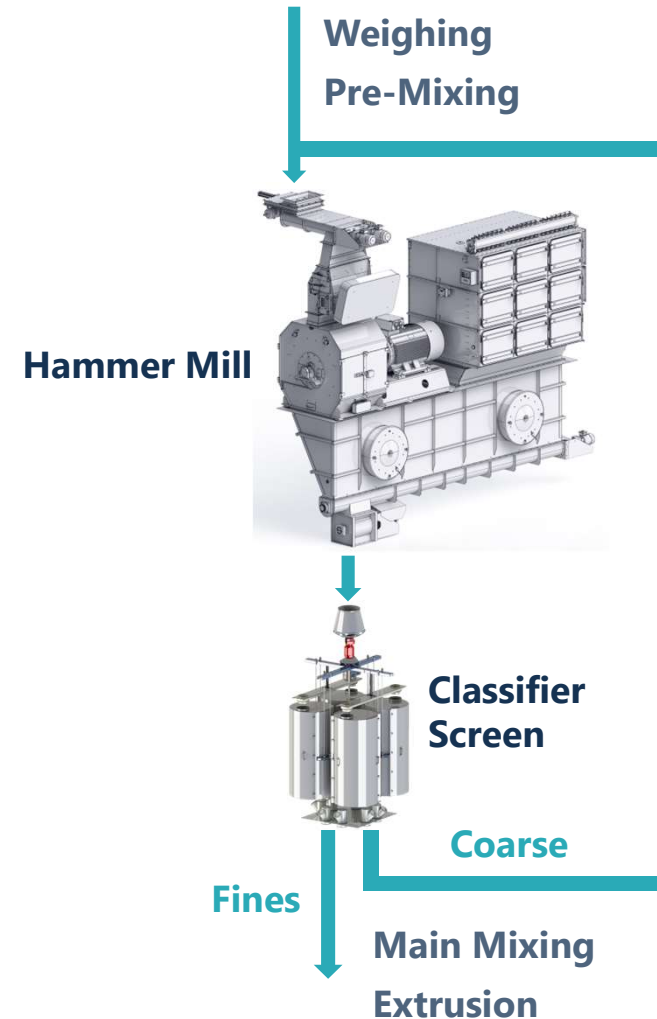


Grinding Concepts

Circular Grinding

- ✓ **Protection of buffer silo or extruder in case of screen damage in hammer mill**
- ✓ Energy savings possible*
- Higher footprint
- Higher investment costs
- More maintenance
- Elevator required
- **Longer dead times between batches can affect Production capacity**

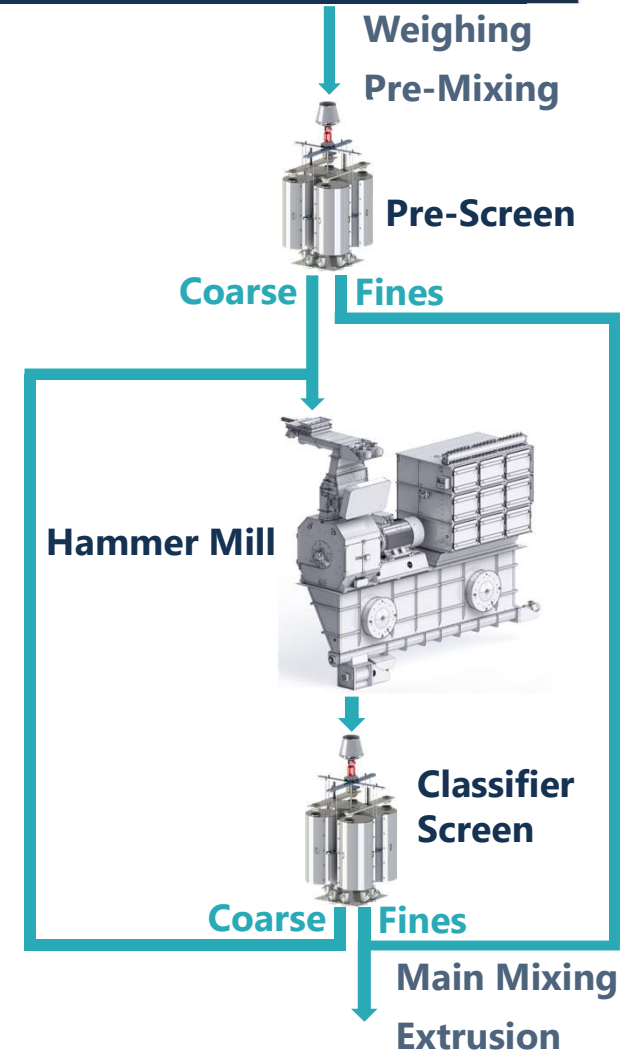
* Depending on fineness and hammer mill screen diameter



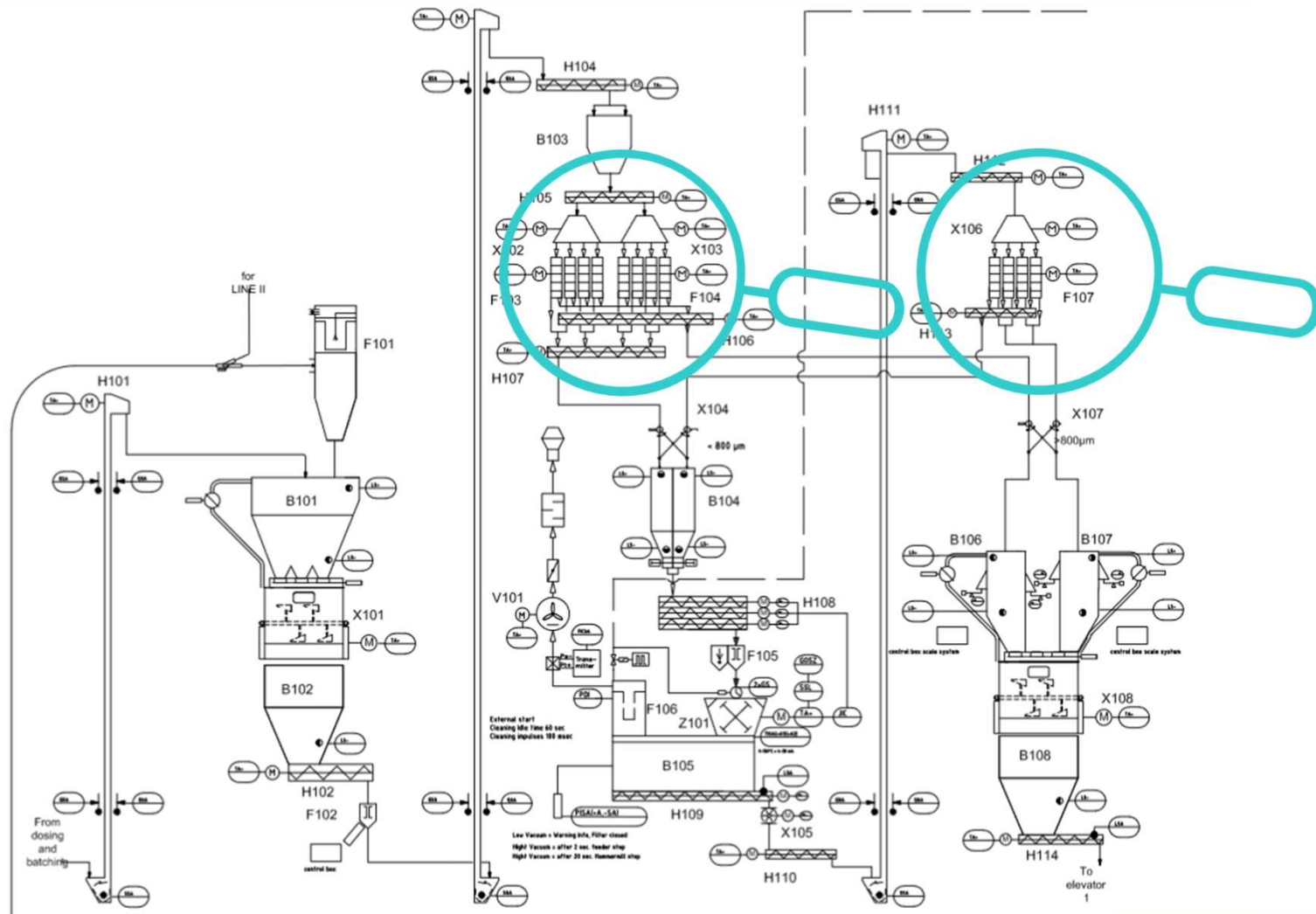
Grinding Concepts

Pre-Screening and Circular Grinding

- ✓ Energy savings, no grinding of fines
- ✓ Protection of buffer silo or extruder in case of screen damage in hammer mill
- Higher footprint
- Higher investment costs
- More maintenance
- **Coarser grist spectrum**
- Elevator required
- **Longer dead times between batches can affect Production capacity**



Grinding Concepts



Crossyoke- Plansifter



Suitable as:

- Control Screen
- Pre-Screen
- Classifier Screen

Grinding Concepts – Screening Equipment

Tumbler Screen

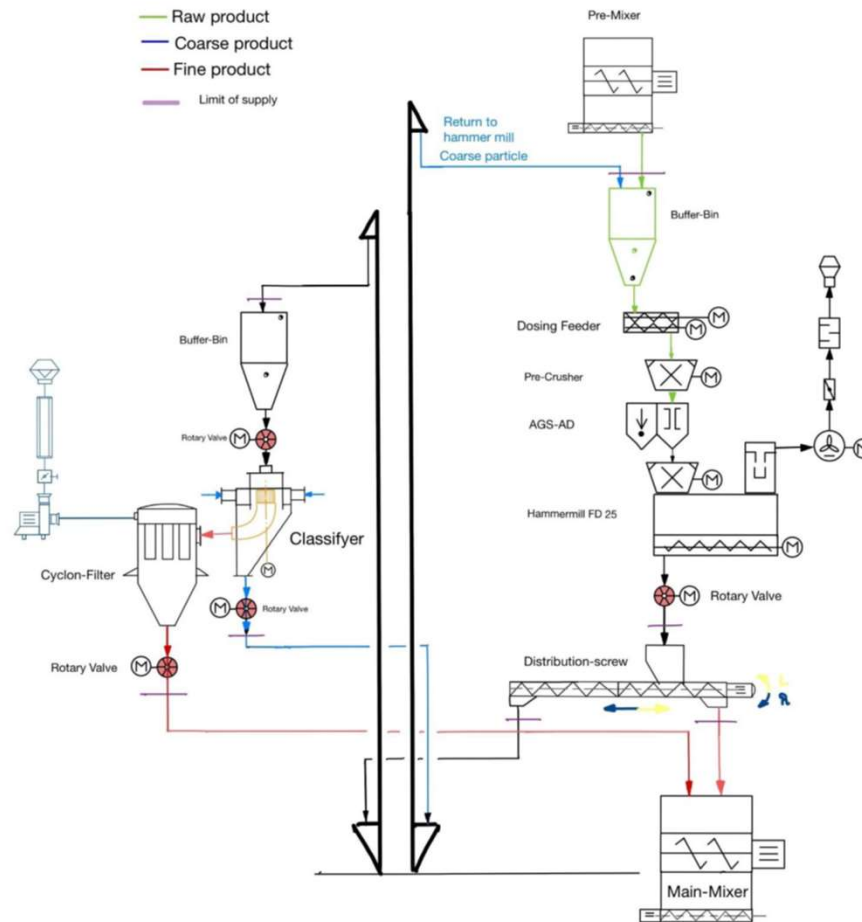
Suitable as:

- Control Screen
- Pre-Screen



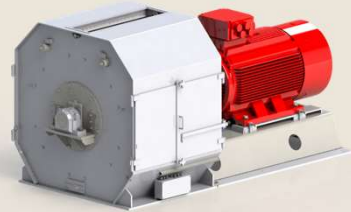
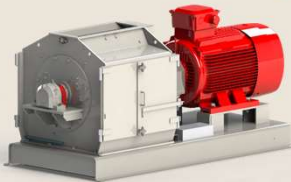
Fine Grinding HM plus Air Classifier

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Potential Savings in Circle Grinding

Double Grinding

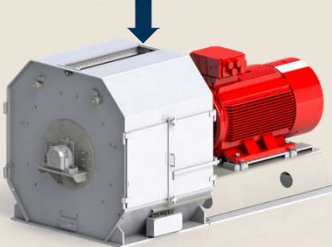
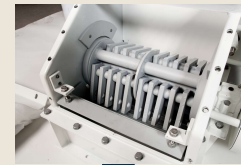


Pre-Grinder
VDK 9.1
132 kW
Main Grinder
GD 20
200 kW
Accessories
Ventilator
37 kW
Transport
10 kW

379 kW

Total Nominal Energy Consumption

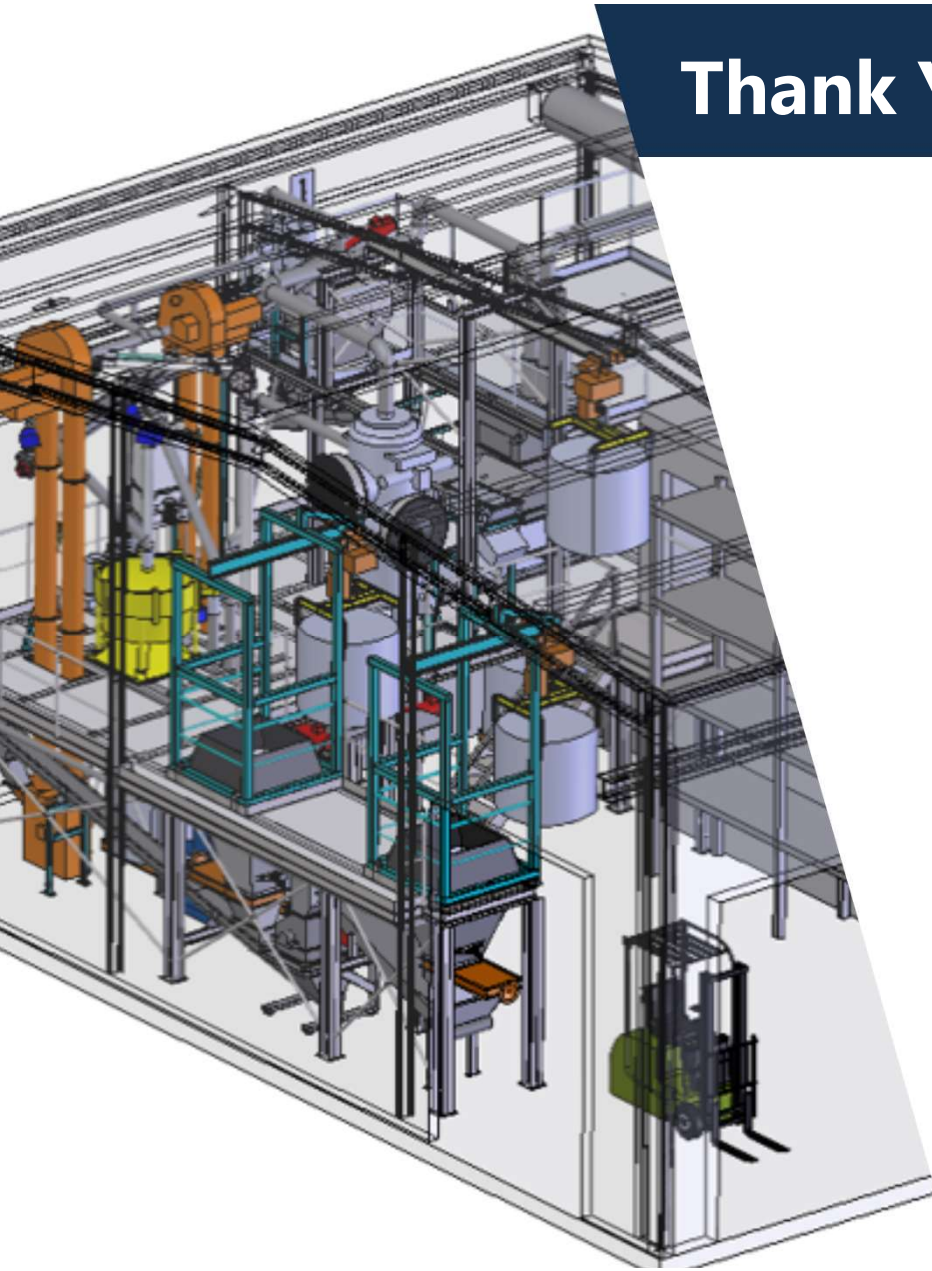
Circle Grinding



Pre-Crusher
Cracker
30 kW
Sifting Technology
Sifter
3 kW
Main Grinder
GD 12
110 kW
Accessories
Ventilator
22 kW
Transport
20 kW

185 kW

Total Nominal Energy Consumption



Thank You!

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