Making the Grade
*Size and Density Separation Principles for Milling Grains*

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Technology Manager – Asia & Australia

Strong Seed. Healthy Grain. PETKUS.
- founded 1852 by the Röber family

- was the first company in the world to develop mechanical seed-cleaning machinery
PETKUS Group

COMMUNICATION CENTER

R&D Activity

Seed & Grain Technology

PETKUS Technologie GmbH

Flour & Feed Technology

PETKUS Engineering GmbH

Silo Construction

P-Balkan
P-Russia
P-Ukraine
P-JUG
P-Czech
P-Kazakhstan
P-Black Sea
P-India
P-China
P-Asia
P-Australia

Customer

INNOVATION / TECHNOLOGIE / ENGINEERING / SERVICE

... managing the total value chain from development to service
PETKUS Feed & Food

competence in grain handling and processing
- grain handling
- grain drying
- grain storage
- grain separating and grading
- seed processing
- flour milling
- milling for starch
- milling for bioethanol
- feed milling
- specialty milling
Asia Engineering Hub – Bangkok, Thailand

Opened 2015  100% German Owned

Project Engineering, Sales & Service

Mission: To bring products and services closer to Asia and Australia
Making the Grade

*Size and Density Separation Principles for Milling Grains*

- Size
- Air resistance
- Specific gravity
- Shape
- Natural peculiarities e.g., texture, colour
### Cut-off characteristics & cut sections

Physical cut-off characteristics of cereals & respective underlying cleaning technology

<table>
<thead>
<tr>
<th>Cereal grain traits</th>
<th>Cleaning technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width &amp; thickness</td>
<td>Screens, air sifter, air screen cleaner</td>
</tr>
<tr>
<td>Length</td>
<td>Indented cylinder, disc separator</td>
</tr>
<tr>
<td>Sink rate</td>
<td>Air sifter, air screen cleaner</td>
</tr>
<tr>
<td>Surface quality</td>
<td>Magnetic cleaner</td>
</tr>
<tr>
<td>Roll characteristics</td>
<td>Belt sorter, sprials</td>
</tr>
<tr>
<td>Specific weight</td>
<td>Gravity table, destoner</td>
</tr>
<tr>
<td>Bouncing ability</td>
<td>Chamber table</td>
</tr>
<tr>
<td>Colour</td>
<td>Colour sorter</td>
</tr>
</tbody>
</table>

Source: www.die-gruene-speisekammer.de
Why Clean?

FOOD PURITY
- Contamination
- Discolouration
- Odour and taint
- Consumer appeal

MILLING EFFICIENCY
- Wear and tear on equipment
- Yield improvement
- Product specification maintenance
Preservation and Cleaning Together

Insect activity is particularly prevalent in stored grain containing broken kernels and screenings

Confused Flour Beetle Survival in 8% Moisture Wheat:

Cotton et al 1960 & Bhadriraju Subramanyam, KSU, IAOM SE Asia Conference 2013
Separation Situations for Wheat

- Intake/Receiving/Pre-Storage
- Pre-Cleaning
- Mill Cleaning
- Seed Cleaning

What do they mean and what is the difference?
Cut-off characteristics & cut sections

The figure shows the composition of the uncleaned grain lot and which components have to be separated according to the straight cut.

A = coarse cleaning
B = pre-cleaning
C, D = industrial cleaning (wheat milling)
E = commercial seed cleaning / grading
Cleaning – Know your grain

- Dimensions change – growing conditions, variety, origin

Grain dimensions: length, width, thickness & centre of gravity
Techniques for Size Separation

Drum Sieve
Techniques for Size Separation

Vibrating

Reciprocating
Vibrating

Vibration - ~1,000 / Minute +/- ~2mm
Vibration ~1,000 / Minute

- Some grains do not have time to fall before they are hit with the sieve in the opposite direction.
- Small defects are carried above the deck due to stratification.

Grain is ‘Cleaned’ but not accurately sized
Vibrating -

**Advantages:**
Simplicity of Machines
Capacity

**Disadvantages:**
Accuracy of Separation
Sieve Cleaning
Cost of Alternative Sieve Sizes
Aspiration Air Volumes
PETKUS SM30 Cleaner

- ‘Traditional’ Construction
- 2 Sieve Layers
- ~ 60 tph (1,500mm wide)
- ~ 7,200 m³/hr (7.5 – 11kW fan)

Fig. 5  Screening Machine with Two Screen Layers

1. distribution route
2. inlet with guiding plates
3. top screen
4. bottom screen
5. discharge of overflow of top screen
6. discharge of bottom screen papa
7. final aspiration duct
8. exit floor
PETKUS SM30 Cleaner

- Double Construction
- 4 Sieve Layers

~ 120 tph (1,500mm wide)

~ 7,200 m³/hr (7.5 – 11kW fan)

*Double capacity for same floor space and exhaust!*
PETKUS SM72 Cleaner

- Double - Double Construction
- 8 Sieve Layers

~ 240 tph

~ 12,000 m³/hr (11 – 18kW fan)

*High capacity intake cleaning
*With minimum space and power*
PETKUS SM72 Cleaner – 240 TPH Wheat
PETKUS SM72 Cleaner – Dust/Light Material Capture at Machine – But NOT Closed Circuit
Reciprocating / Oscillation

Movement - ~300 x Minute   - +/-15mm
Oscillation ~300 / Minute

Grain has time to fall through sieves
Less stratification

Grain is ‘Cleaned’ AND Accurately Sized
Reciprocating / Oscillation -

**Advantages:**
Accurate Sizing
Better cleaning of top sieve
Better aspirators/true air sifting
Most dust/light material discharged at machine
Easy/lower cost sieve changes

**Disadvantages:**
Higher initial cost
PETKUS V15 Cleaner – 150 TPH Wheat Pre-Cleaning
Aspirator / Air Sifter

Pre-Aspiration  Sieves  Post/Tail Aspiration
Aspirator / Air Sifter

Ratio of proportions separated by bottom screen versus air sifter

<table>
<thead>
<tr>
<th>Proportions to be separated (%)</th>
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<tbody>
<tr>
<td>Complete proportions which have to be separated (%)</td>
</tr>
<tr>
<td>Absolut separation from bottom screen (%)</td>
</tr>
<tr>
<td>Absolut separation from air sifter (%)</td>
</tr>
</tbody>
</table>

- Pre-cleaning wheat: 100%, 100%, 62%, 30%
- Pre-cleaning winter barley: 100%, 100%, 22%, 10%
- Commercial seed cleaning wheat: 100%, 89%, 63%, 46%
- Commercial seed cleaning barley: 100%, 93%, 30%, 4%
- Mailing barley: 100%, 80%, 25%, 6%
Functional elements

Air sifter: basic principles and types

Comparison of cut-off effects between different sifter types
Conventional Air Sifter Types

Single Channel

Double Channel
PETKUS Technologie GmbH

PETKUS New Generation of Cleaner 2017
PETKUS New Generation of Cleaner 2017

Aspiration

After Sieving

Layering without fan

Good Seed/Grain
PETKUS New Generation

New Control System, with air speed measurement and recipes

New 2017
Indented Cylinder Type ZA

Long grain sorting

Short grain sorting
Indented Cylinder - Important Design Feature – Short Separation

Agitating/Mixing Device
Tear Drop Pockets and Large Diameter = Better Pick-Up

Figure: scheme of different cell plates and basic calculations
High Capacity: 4 x 900mm diam x 3,000mmm long
The gravity sorting principle

Sorting according to specific weight

- Separation cut-point
- Mean sink speed
- Good/clean grain

2-5 % Separated Part

Distribution / %

Weight / g

Sink speed / m s⁻¹
Optimization: Obvious separation zones
Optimised Destoning

- Taking premium gravity table features and apply them to destoning
- Fully electronic adjustment
- PLC control, with recipe and memory position setting
Optimised Destoning

Central Feeding

Wheat

Stones
Optimised Destoning

Electronic Deck Angle and Fan Adjustment

PLC Control
Making the Grade

*What does it mean….?*

- Choose the right technology for the process
  - *A colour sorter is a very expensive sieve when size is the problem*

- Minimize losses (both cleaning and degradation)

- Minimize energy use

- Use the grain that your competitors cannot
  - *Especially when combined with proper debranning*
Thank You

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