

## Making the Grade

### *Size and Density Separation Principles for Milling Grains*

Roger Cook

Technology Manager – Asia & Australia

Strong Seed. Healthy Grain. PETKUS.



- founded 1852 by the Röber family



1852



1883



1948

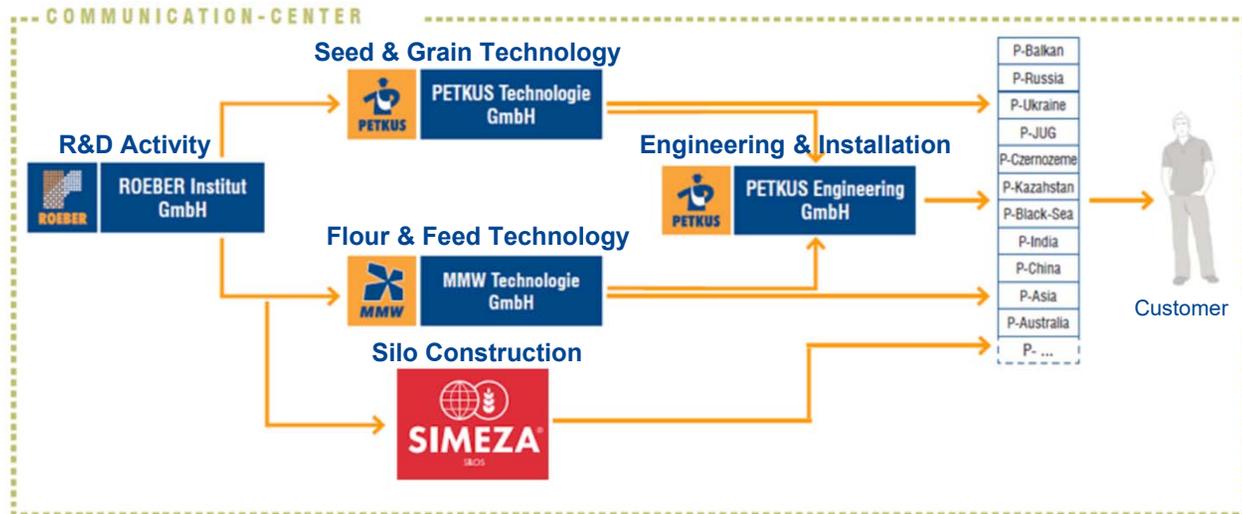


2004

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



## PETKUS Group



INNOVATION

TECHNOLOGIE

ENGINEERING

SERVICE

>> ... managing the total value chain from development to service

## PETKUS Feed & Food

MMW and PETKUS



### 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

Cereal grain traits	Cleaning technology
Width & thickness	Screens, air sifter, air screen cleaner
Length	Indented cylinder, disc separator
Sink rate	Air sifter, air screen cleaner
Surface quality	Magnetic cleaner
Roll characteristics	Belt sorter, spirals
Specific weight	Gravity table, destoner
Bouncing ability	Chamber table
Colour	Colour sorter



## Why Clean?

### FOOD PURITY

- Contamination
- Discolouration
- Odour and taint
- Consumer appeal

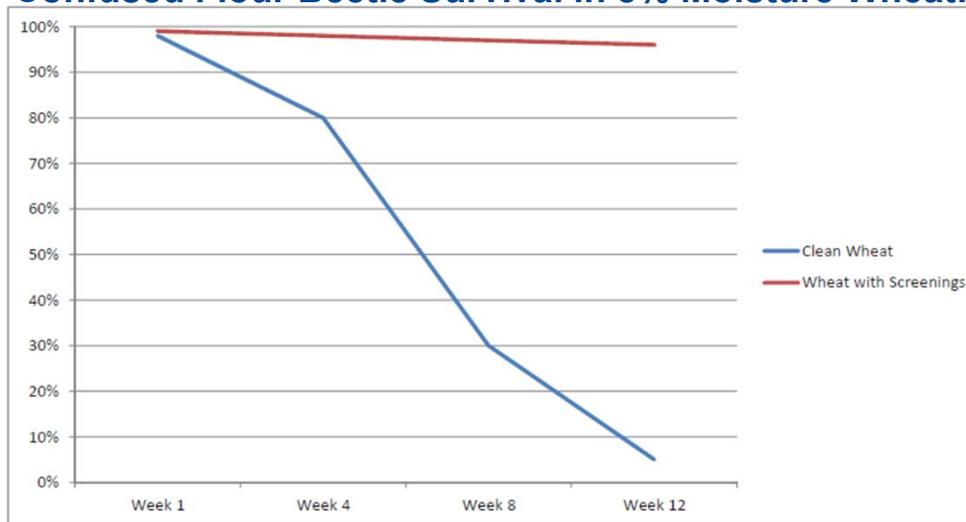
### MILLING EFFICIENCY

- 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:



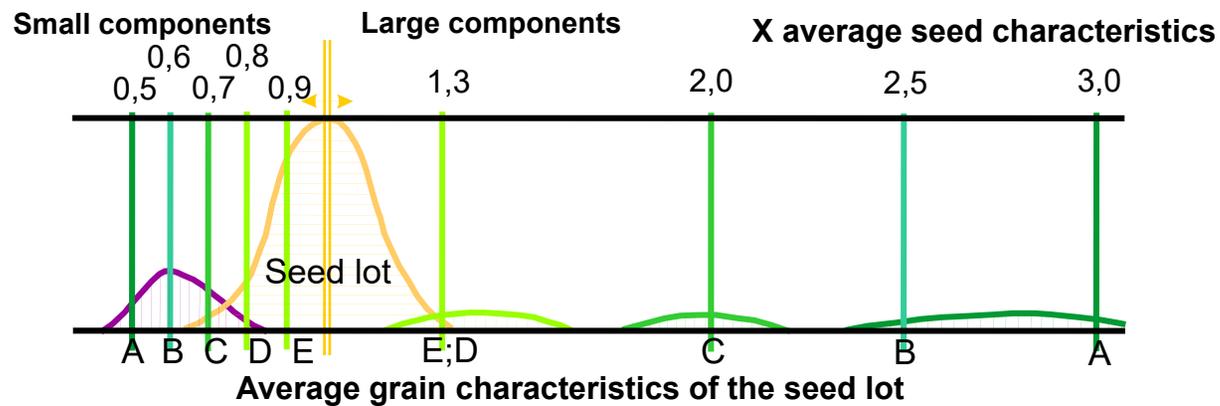
Cotton et al 1960 & Bhadriraju Subramanyam, KSU, IAOM SE Asia Conference 2013

## 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



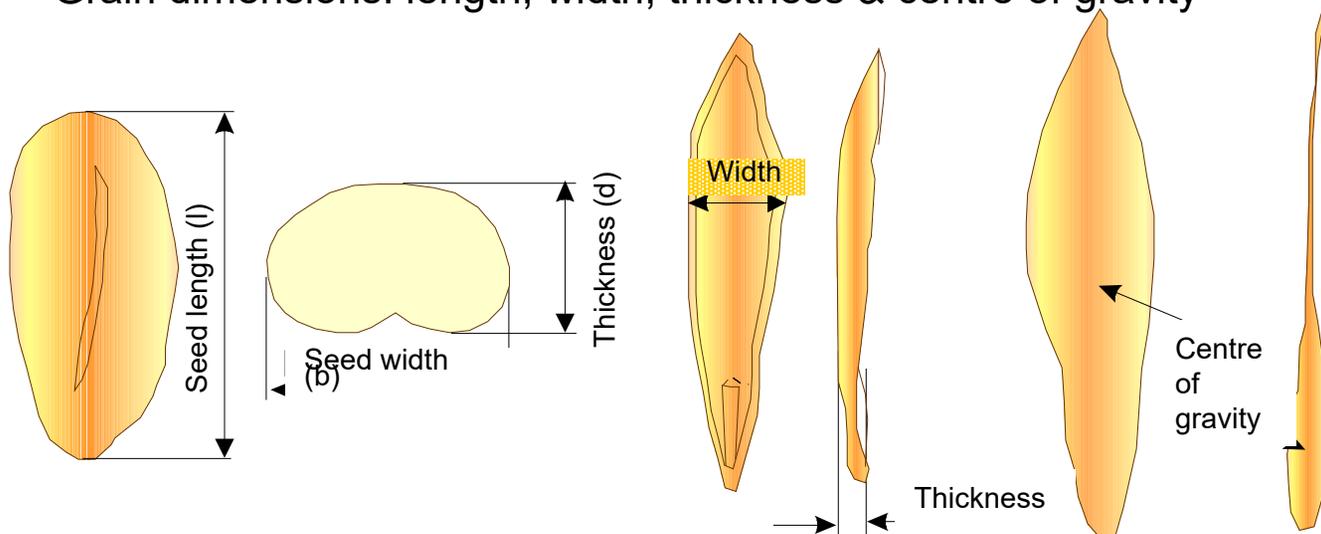
The figure shows the composition of the uncleaned grain lot and which components have to be separated according to the straight cut.

- 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

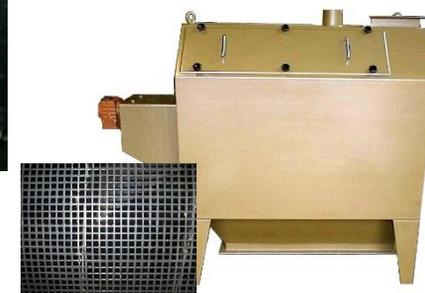
Grain dimensions: length, width, thickness & centre of gravity



## Techniques for Size Separation



**Drum Sieve**



## Techniques for Size Separation

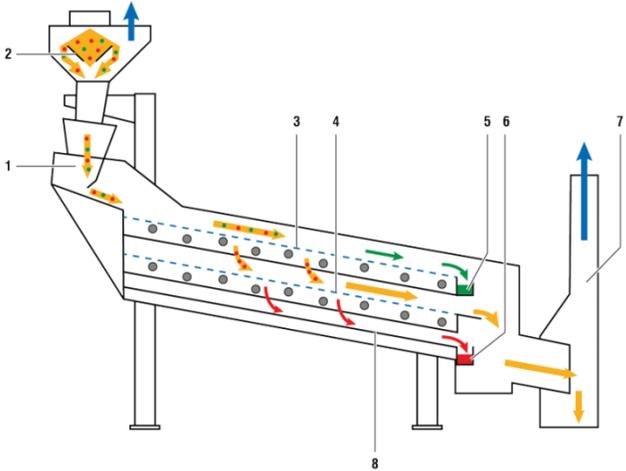
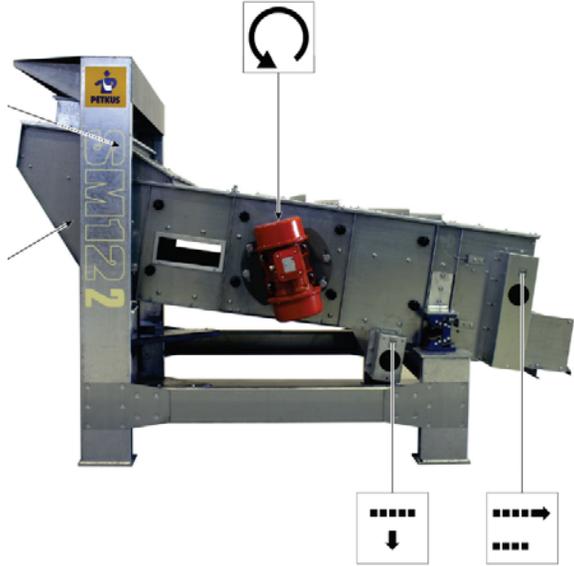


**Vibrating**



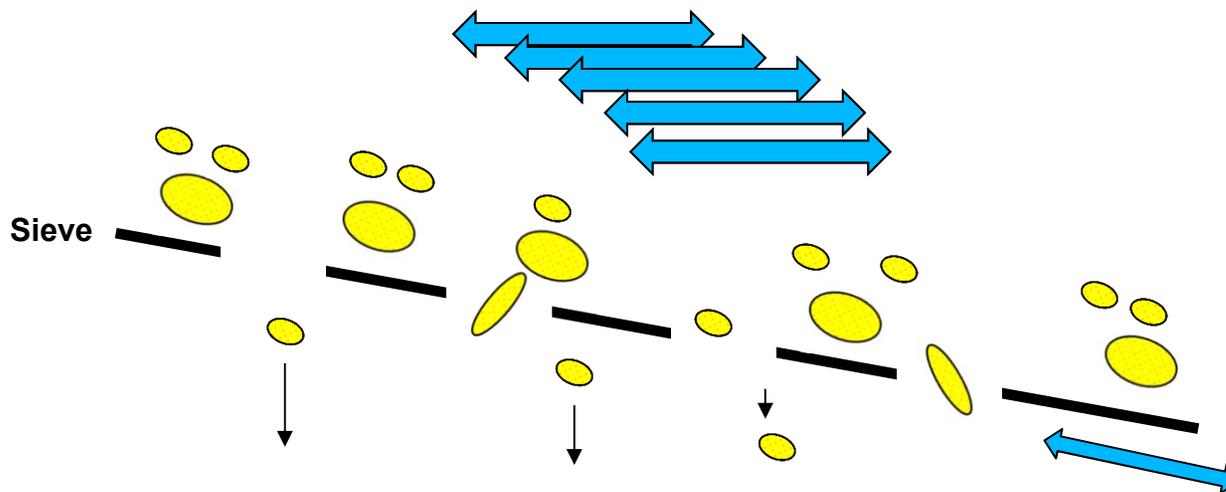
**Reciprocating**

# 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 m<sup>3</sup>/hr (7.5 – 11kW fan)

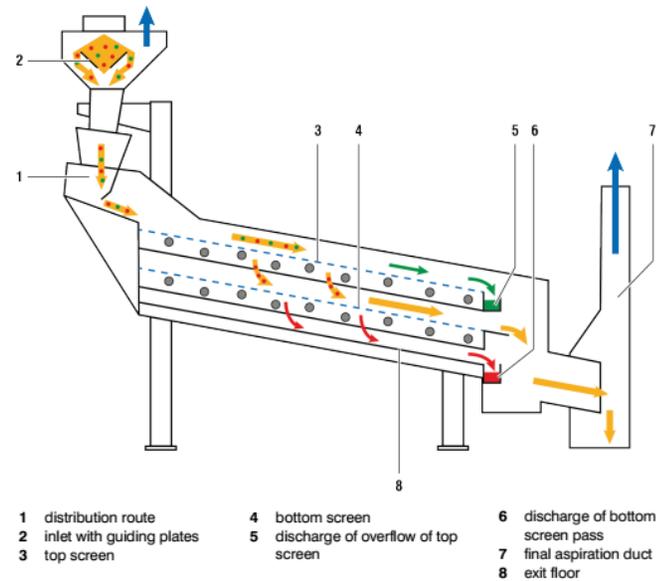


Fig. 5 Screening Machine with Two Screen Layers

## PETKUS SM30 Cleaner

- Double Construction
- 4 Sieve Layers
- ~ 120 tph (1,500mm wide)
- ~ 7,200 m<sup>3</sup>/hr (7.5 – 11kW fan)

*Double capacity for same floor space and exhaust!*

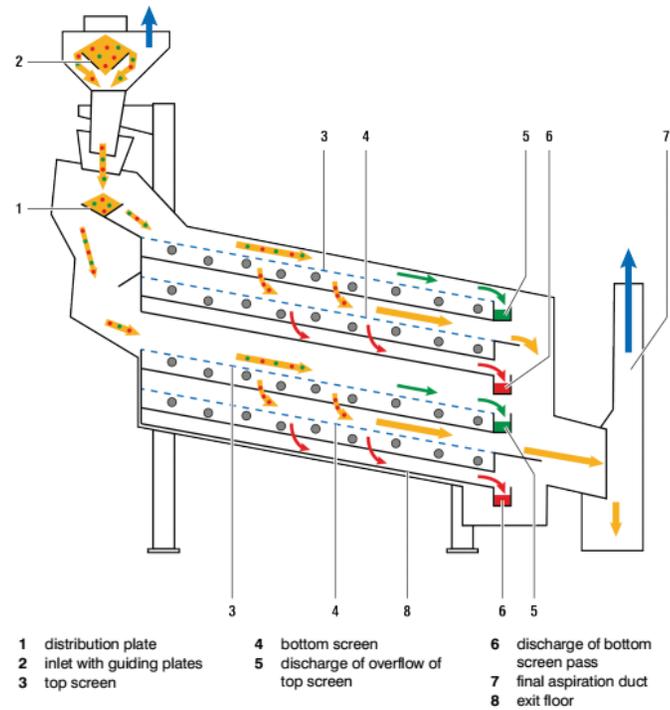


Fig. 6 Screening Machine with Four Screen Layers

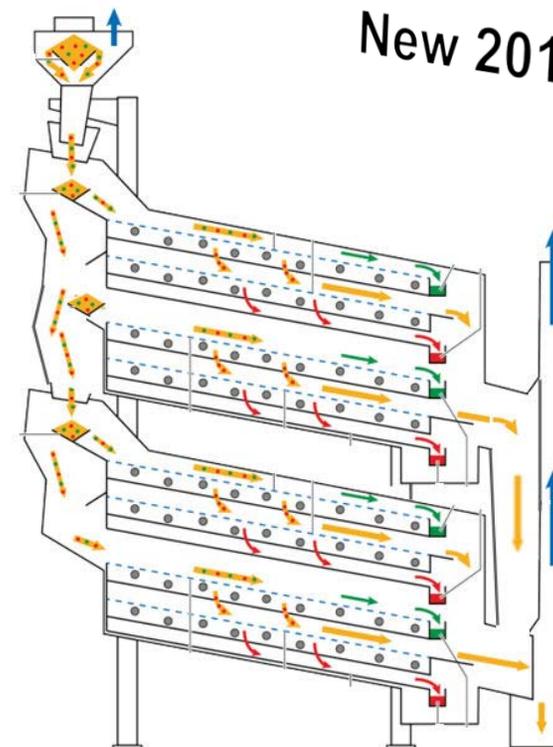
## PETKUS SM72 Cleaner

- Double - Double Construction
- 8 Sieve Layers

~ 240 tph

~ 12,000 m<sup>3</sup>/hr (11 – 18kW fan)

*High capacity intake cleaning  
With minimum space and power*



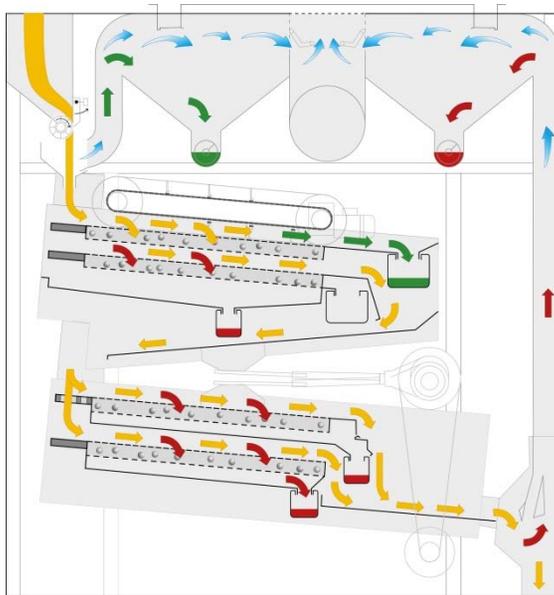
## PETKUS SM72 Cleaner – 240 TPH Wheat



## PETKUS SM72 Cleaner – Dust/Light Material Capture at Machine – But NOT Closed Circuit



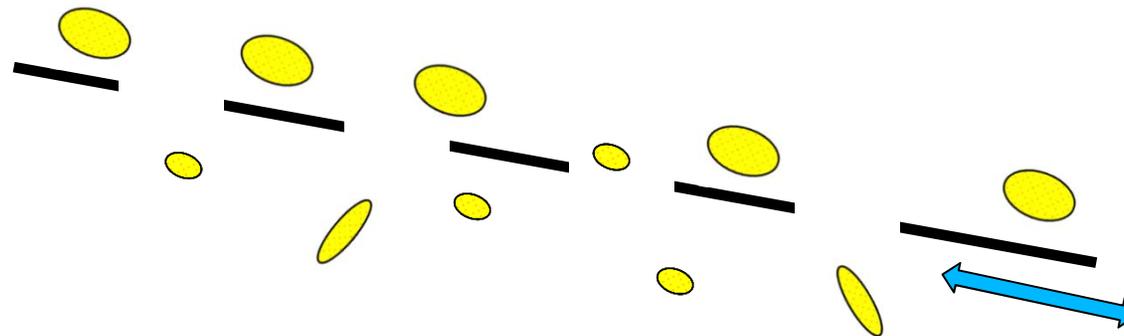
## Reciprocating / Oscillation



- 1 Feeding system
- 2 Scraper chain
- 3 Screen shoe with rubber ball cleaning
- 4 Air separator
- 5 Double channel air separator

**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

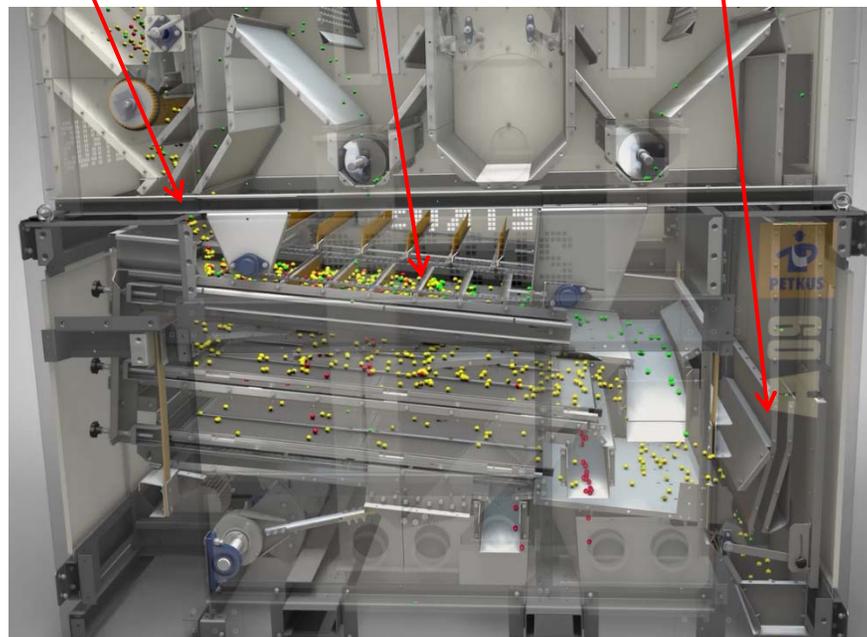


## Aspirator / Air Sifter

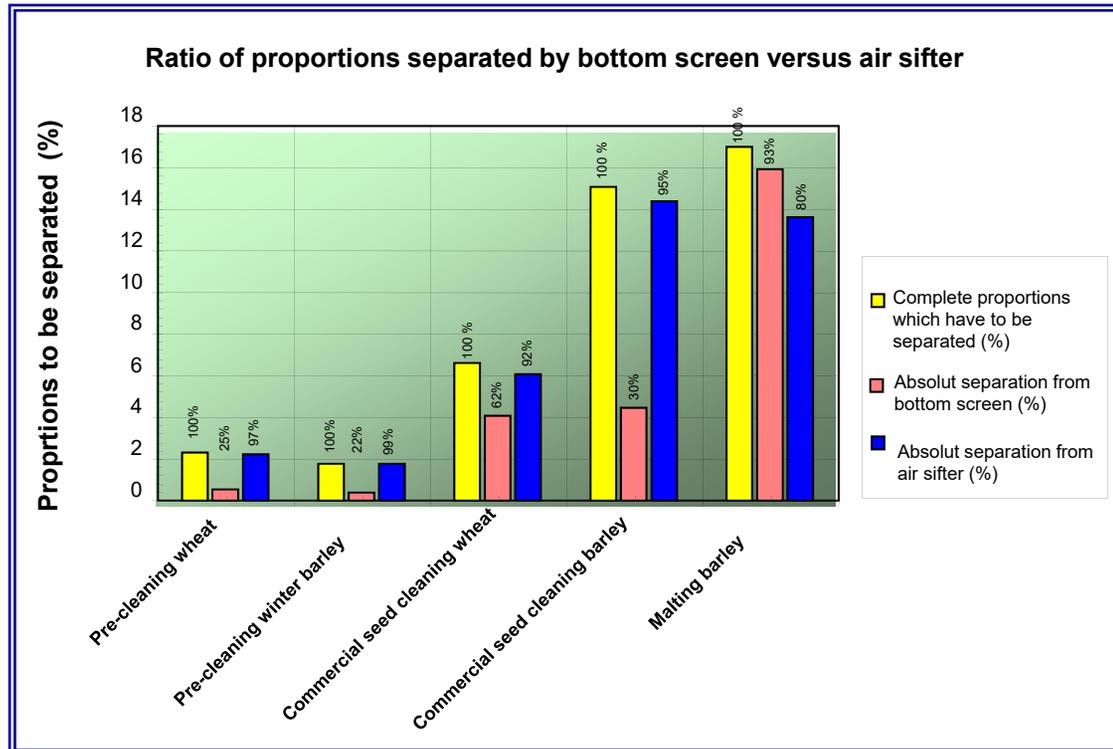
Pre-Aspiration

Sieves

Post/Tail Aspiration



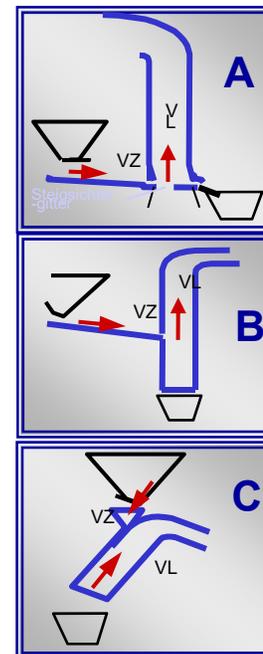
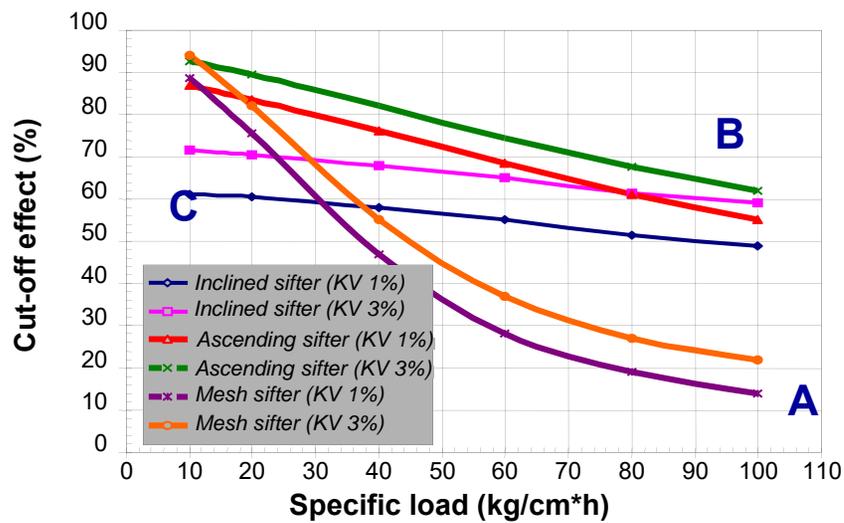
Aspirator / Air Sifter



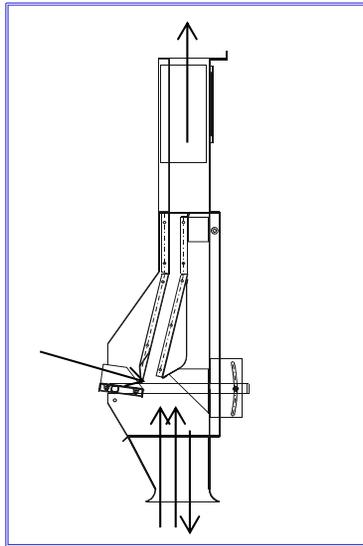
### Functional elements

### Air sifter: basic principles and types

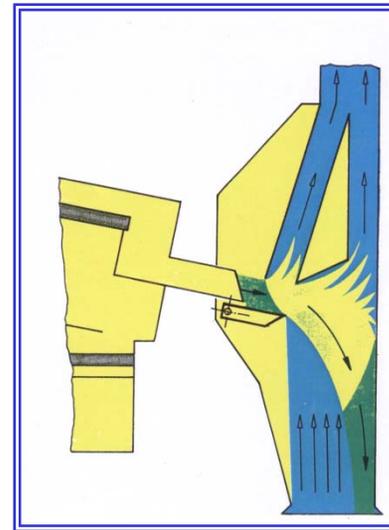
Comparison of cut-off effects between different sifter types



## Conventional Air Sifter Types



Single Channel

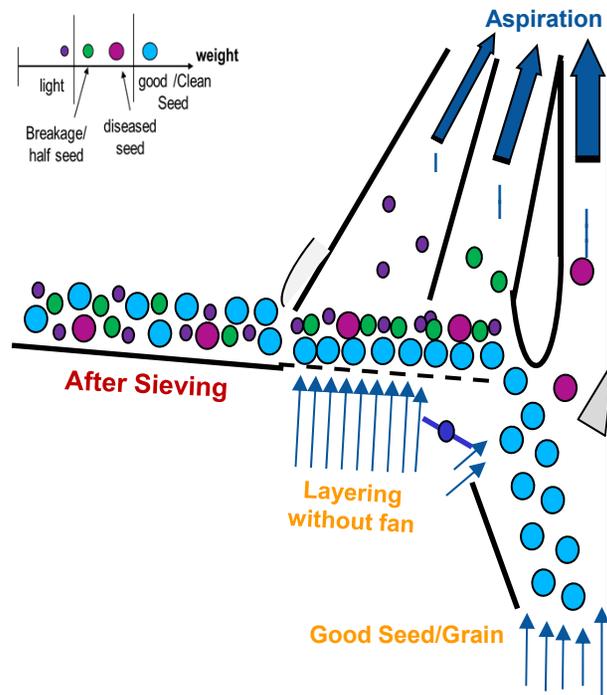


Double Channel

PETKUS New Generation of Cleaner 2017



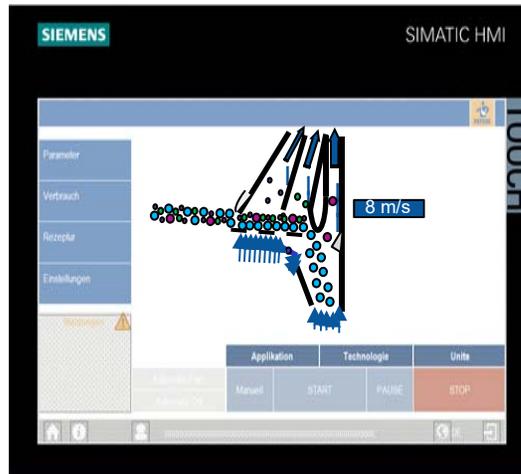
### PETKUS New Generation of Cleaner 2017



PETKUS New Generation

New 2017

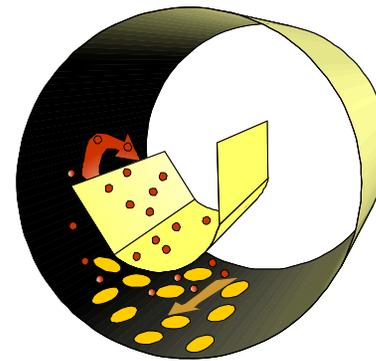
*New Control System, with air speed measurement and recipes*



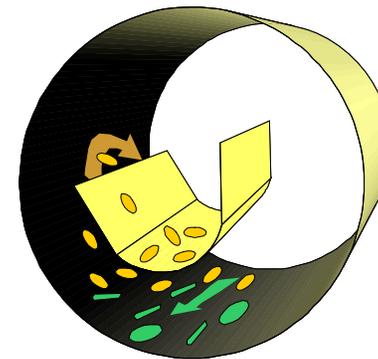
### Indented Cylinder Type ZA



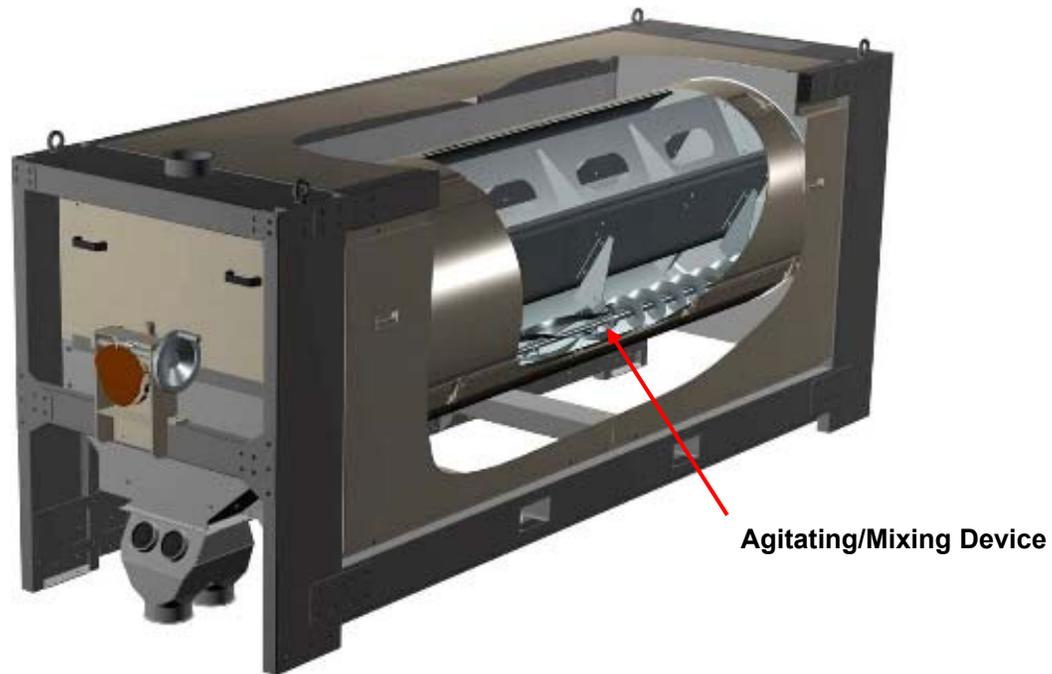
Long grain sorting



Short grain sorting



### Indented Cylinder - Important Design Feature – Short Separation



### Tear Drop Pockets and Large Diameter = Better Pick-Up

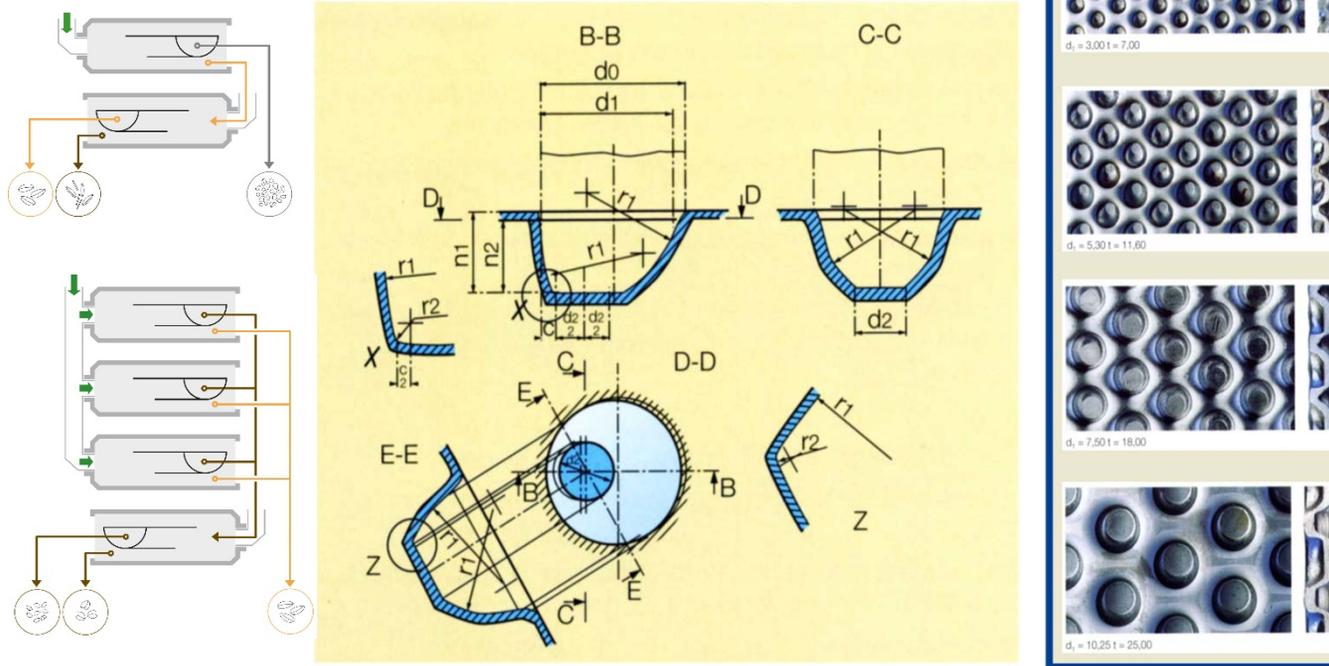
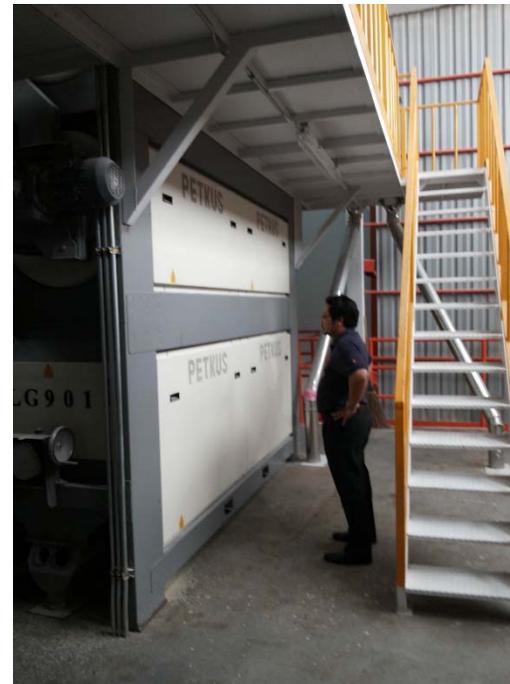


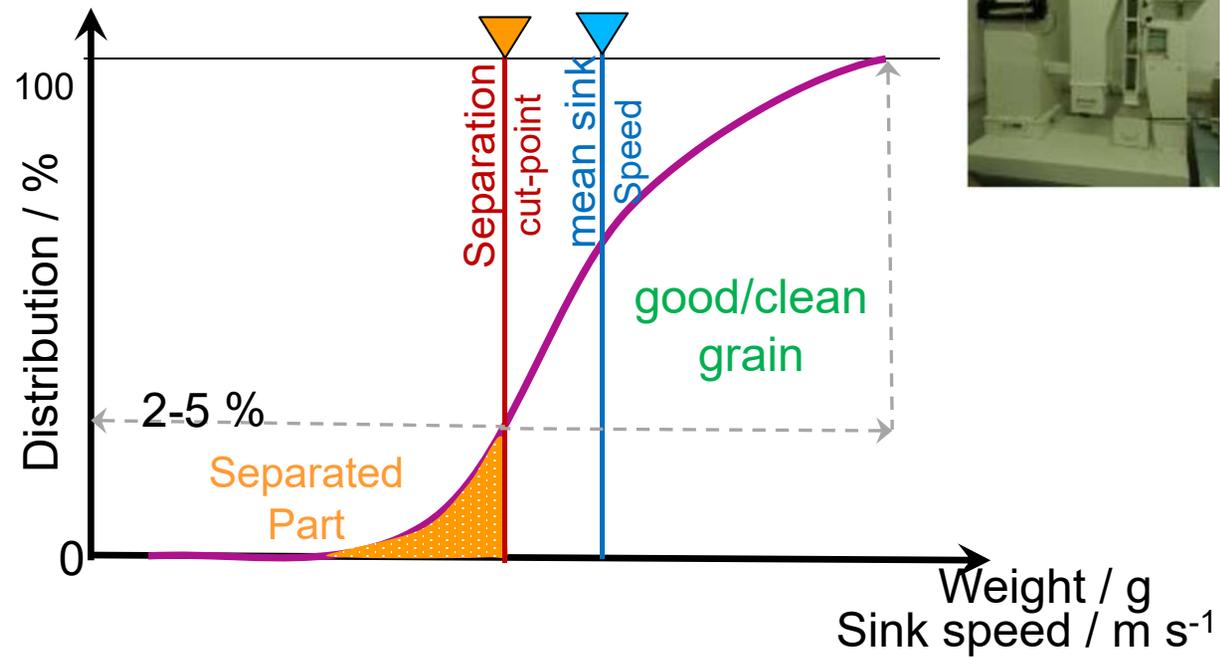
Figure: scheme of different cell plates and basic calculations

**High Capacity: 4 x 900mm diam x 3,000mm long**

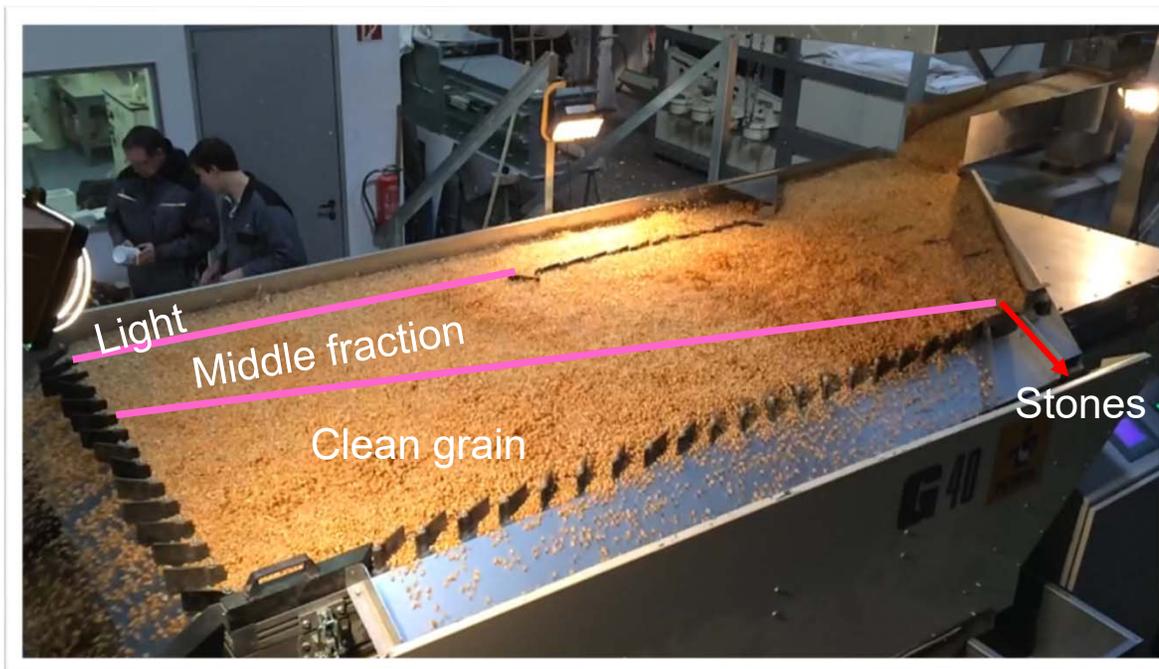


### The gravity sorting principle

Sorting according to specific weight



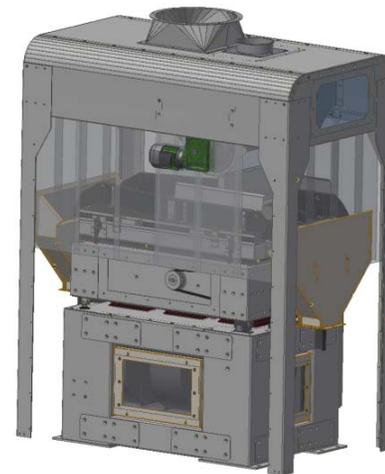
### Optimization: Obvious separation zones



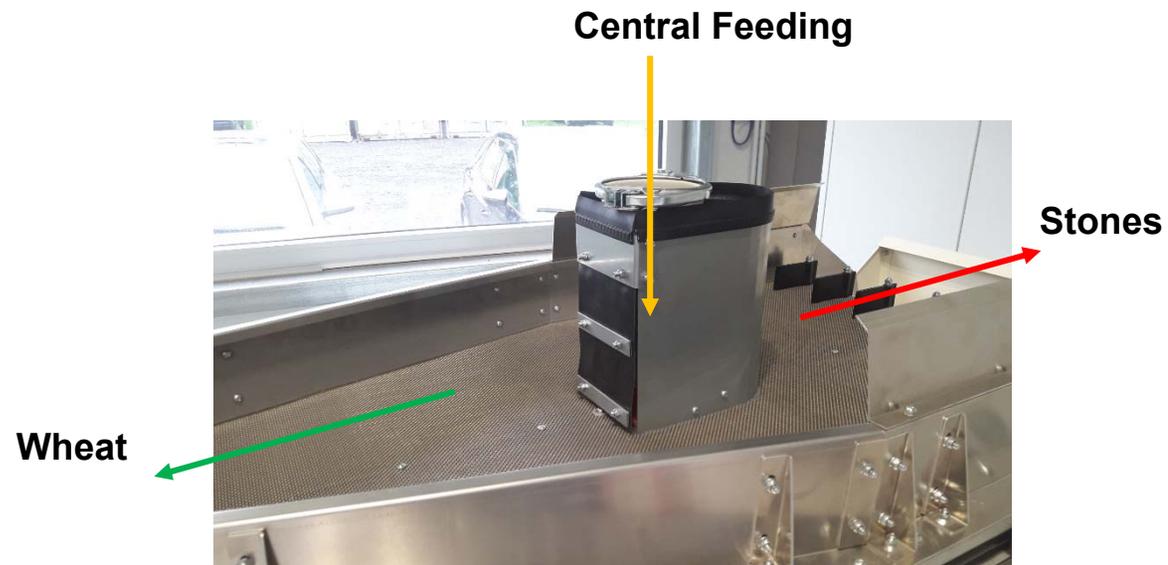
## Optimised Destoning

New 2017

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



## Optimised Destoning



## 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**

**Roger Cook**  
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