Atta Flour vs. Whole Meal Flour – Specific properties and different technologies for production

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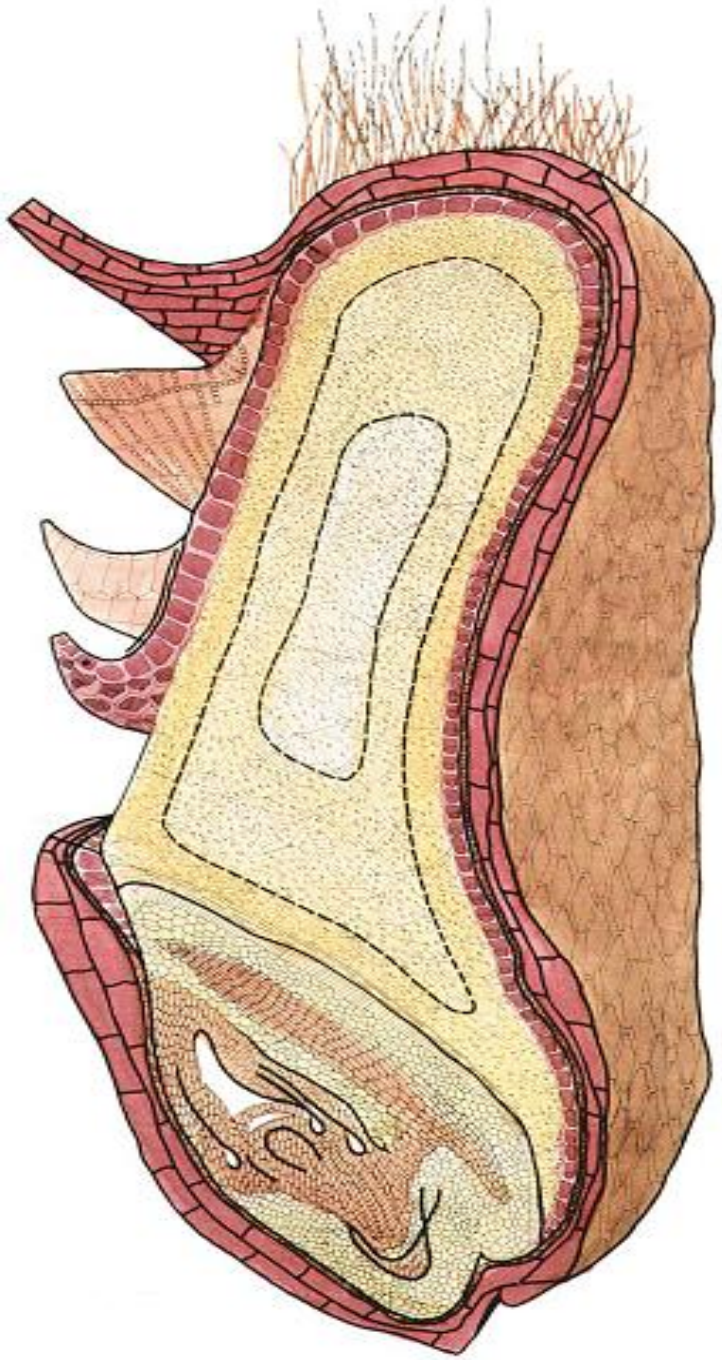
Why should we eat Whole Meal products?

- High Fiber content
- Considered to be healthier than white bread and rice
- Nutritional value (mineral and vitamin content)
- Higher sustainability

Nutritional Value

- Most of the vitamins, minerals and dietary fibers are in the germ and in the bran.
- By producing white flour we loose a lot of the nutritional properties.



Nutritional value per 100 g (3.5 oz)		
Energy	1,368 kJ (327 kcal)	
Carbohydrates	71.18 g	
Sugars	0.41	
Dietary fiber	12.2 g	
Fat	1.54 g	
Protein	12.61 g	
Vitamins	**Quantity**	**%DV†**
Thiamine (B_1)	0.383 mg	33%
Riboflavin (B_2)	0.115 mg	10%
Niacin (B_3)	5.464 mg	36%
Pantothenic acid (B_5)	0.954 mg	19%
Vitamin B_6	0.3 mg	23%
Folate (B_9)	38 µg	10%
Choline	31.2 mg	6%
Vitamin E	1.01 mg	7%
Vitamin K	1.9 µg	2%
Minerals	**Quantity**	**%DV†**
Calcium	29 mg	3%
Iron	3.19 mg	25%
Magnesium	126 mg	35%
Manganese	3.985 mg	190%
Phosphorus	288 mg	41%
Potassium	363 mg	8%
Sodium	2 mg	0%
Zinc	2.65 mg	28%
Other constituents	**Quantity**	
Water	13.1 g	
Selenium	70.7 µg	

Different cereals can be used for Whole Meal products.

Definition of Whole Meal Flour

- Different names of Whole Meal Flour:
  Whole Meal, Whole Wheat, Whole Grain…
- For a long time there is a discussion to find a definition in the EU
  → Looks like >98% will be approved
- Flour with yield of 80% - 98% are often called «Brown Flour»

Source	Definition
EU	„Whole grain means grains from which only part of the end has been removed, irrespective of characteristics produced at each stage of milling”
AACC 2000	„Whole grains shall consist of the intact, ground, cracked, or flaked caryopsis, whose principle anatomical components – the starchy endosperm, germ and bran – are present in the same relative proportions as they exist in the intact caryopsis“
Health Grain 2014	Whole grains shall consist of the intact, ground, cracked, or flaked kernel after the removal of inedible parts such as the hull and husk. The principal anatomical components, the starchy endosperm, germ and bran are present in the same relative proportions as they exist in the intact kernel. Small losses of components that is less than 2% of the grain, 10% of the bran that occur through processing methods consistent with safety and quality are allowed”

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Whole Meal Flour different variations

- Large variety of Whole Meal Flour
- Granulation → depending on grinding process and market requirements
- Color → depending on wheat variety and granulation
- Taste → depending on wheat variety and starch damage

Whole Meal Bread

Market:

- Large variety of different Whole Meal bread and buns.
- Depending on region, either loafs / buns, or flat bread are known.

Challenge:

- Volume of bread loafs or buns are always reduced compared to ones produced out of a white flour (based on same wheat quality)

Parameters for Whole Meal Flour

- Depending on bread type and consumer expectation different parameters are important:
  - Granulation (mouth feeling, appearance)
  - Water absorption
  - Protein / Gluten Quality (elasticity of dough)
  - Moisture

- Shelf life (Whole Meal flour gets faster rancid)

- Whole Meal Flour are often made without dampening the grain:
  - Longer shelf life
  - Easier to grind the bran

Differences in baking quality

Whole Meal vs. White Flour (~0.65% ash)

White Bread

Protein	11.5%
Gluten	26.0%
Falling Number	290 s
Stability	4-6 min
Volume	3400 ml (1kg loaf)

Whole Meal Bread

Protein	12.5%
Gluten	29.0%
Falling Number	250 s
Stability	2-3 min
Volume	2500 ml (1kg loaf)

Cleaning prior to grinding

Cleaning before grinding is key

- All particles, which are not removed, will be part of the finish product
- The coarser the end product, the better the cleaning needs to be
- Impurities are easy to be recognized in Whole Meal Flour / baked products

→ **For food safety reasons, proper cleaning for the production of Whole Meal Flour, is of utmost importance**

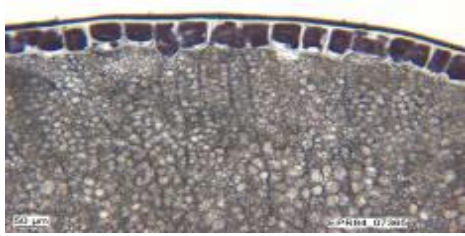
Surface Cleaning

- All adhering particles and contaminations need to be removed, as much as possible, from the surface prior to grinding
- The surface cleaning plays a major role in the product safety of Whole Meal Flours

→ **Intensive surface cleaning is a must**

before Peeling

after Peeling



Different processes for production of Whole Meal Flour

Roller Mills

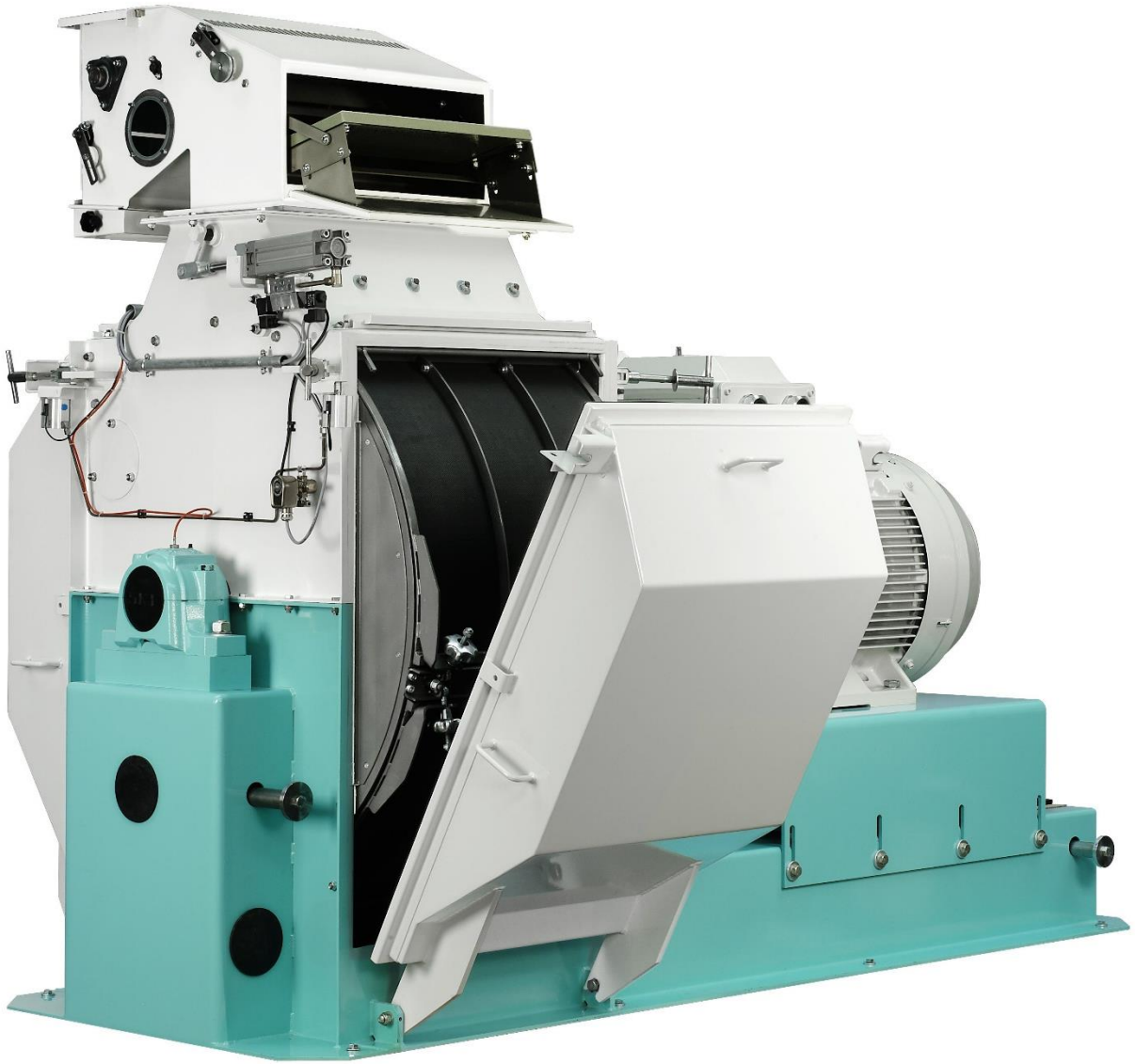
- **Advantages:**
  - Low energy consumption
  - Flexibility to adjust look and feel of product, based on different flutes and grinding styles
  - Selective grinding
  - Adjustment of water absorption and granulation

- **Disadvantage:**
  - Limitation of bran particle size reduction at around 350µ

→ **Flour with good baking properties**

Hammer Mills

- **Advantages:**
  - Simple and easy to use
  - Low investment
  - Granulation can easy be changed by sieve size
- **Disadvantage:**
  - Limitation of bran particle size reduction at around 350µ
  - No selective grinding
  - No adjustment other than sieve size and speed possible
  - Explosion protection mandatory in many countries



→ **Lower baking properties**

Rotor Mills

- **Advantages:**
  - Simple and easy to use
  - Bran particle size <200µ can be reached

- **Disadvantages:**
  - No selective grinding
  - Only parameter, which can be adjusted is granulation
  - High power consumption
  - Explosion protection mandatory in many countries

→ **Lower baking properties**
→ **Ideal if granulation has to be <300µ**

Disc Mills

- **Advantages:**
  - Simple and easy to use
  - Different discs/ cutting tools can be used to achieve different types of granulation and shapes
  - Bran particle size <350µ can be reached

- **Disadvantages:**
  - No selective grinding
  - When producing fine products, a lot of heat is created.

→ **Flour with medium baking properties**

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Stone Mills

- Traditional grinding with Stone Mills.
- Horizontal and vertical types.

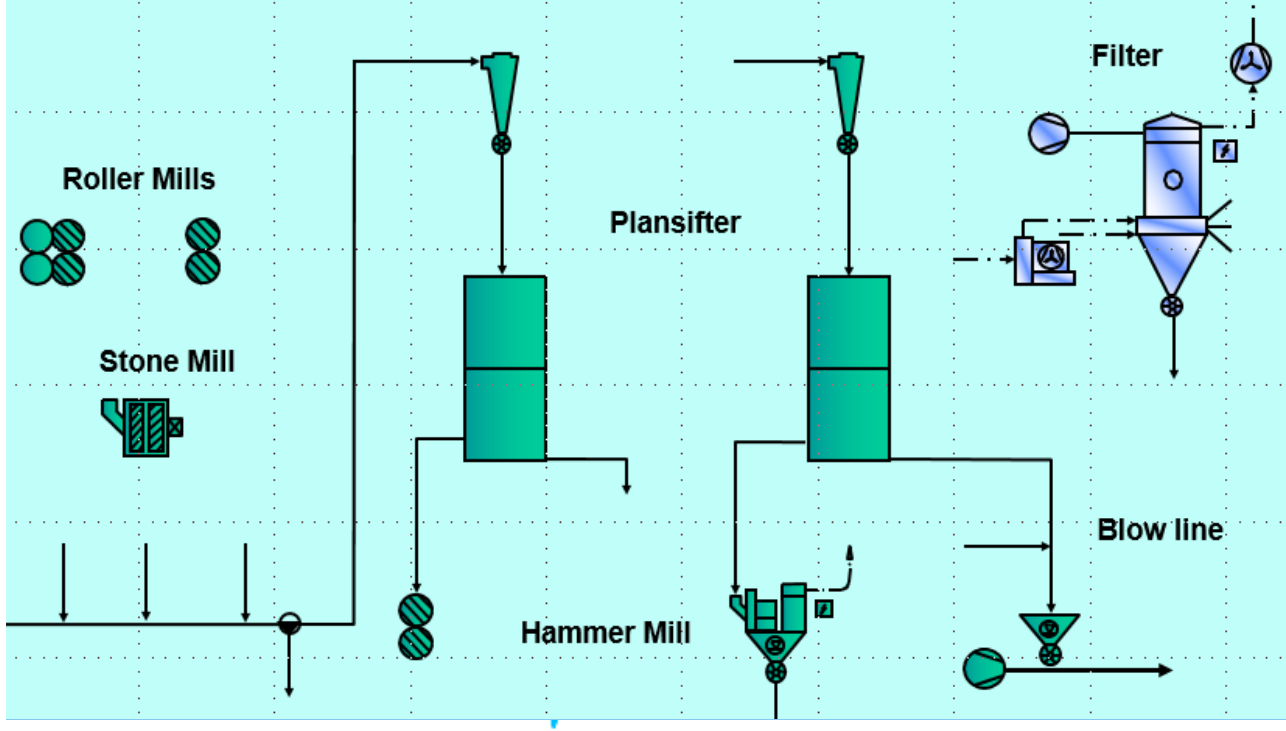
- **Advantages:**
  - Certain flour properties can be achieved by stone grinding.
  - Marketing: in certain markets stone ground flour achieves a higher price.

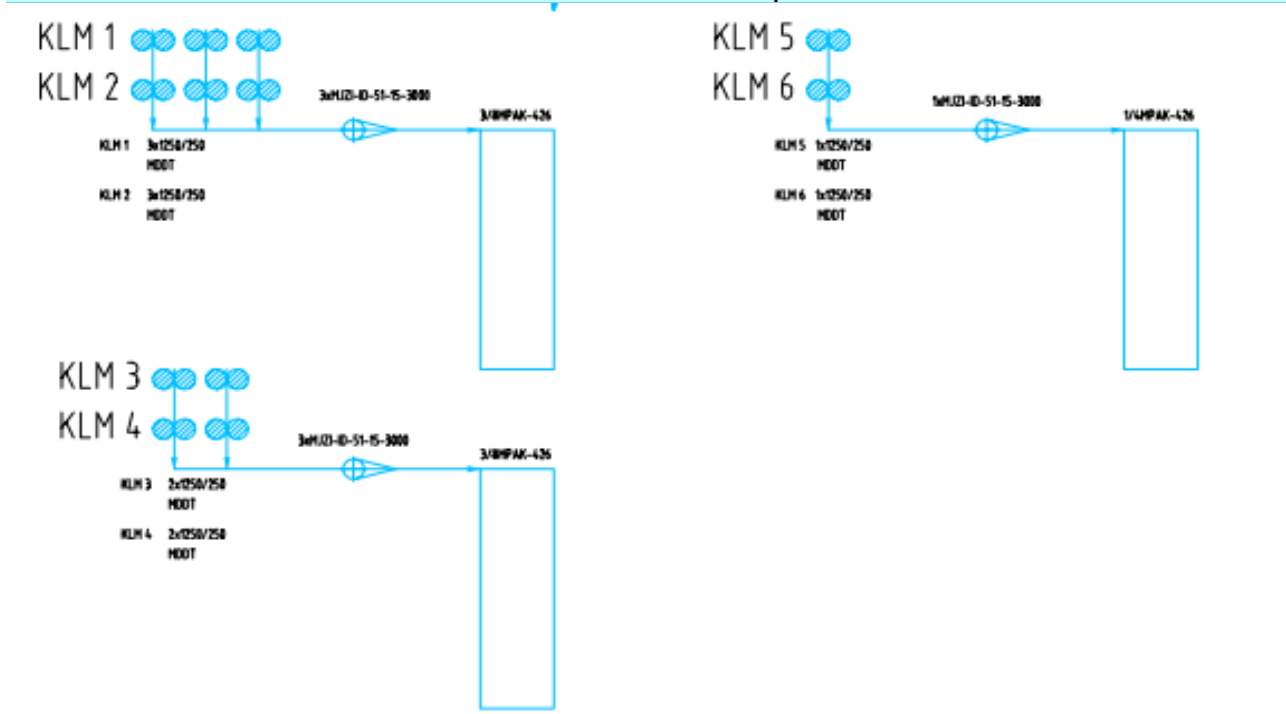
- **Disadvantages:**
  - Food Safety.
  - Stones need regularly to be redressed.
  - Limited capacity.

→ **Good baking properties.**

Flow Sheet for Whole Meal Flour.

- For the Whole Meal Flour production either one type of machine or several different ones are used.
- Here the drivers are, if only one type of flour has to be produced, or several very different types.
- Often a bran grinding system is added to a normal wheat flour mill. This can be based on Roller-, Hammer-, or Rotor Mills.
- A separate process to produce only Whole Meal Flours are used, where volumes are justifying such an investment, or very different products need to be produced.





Summary of Whole Meal Flour for buns and loafs

- Large variety of different Whole Meal Flour and bread
- Wide range of different technologies are used to produce Whole Meal Flour
- Wheat with high protein needed for the volume
- Functionality of gluten should not be affected by grinding process
- Color of bread depends on yield (whole meal / brown flour) and wheat type
- Mouth feeling depends on the granulation. (particle size of bran)

Atta Flour

Quality parameters of Chapatti.

Facts:

- High water absorption
- Good elasticity (gluten)
- Long shelf life (moisture)
- Fine bran particles

Organoleptic parameters:

- Typical aroma
- Taste (sweetish)

Characteristic of Atta Flour.

Process parameters	min.	max.
Starch Damage AACC [%]	11	26
Water absorption [%] dry base	71	83
End moisture[%]	9	11
Temperature after grinding [°C] 20..30s	50	67
Granulation	75-80% <150my	
Extraction / Yield [%]	93	97

Production of Atta Flour

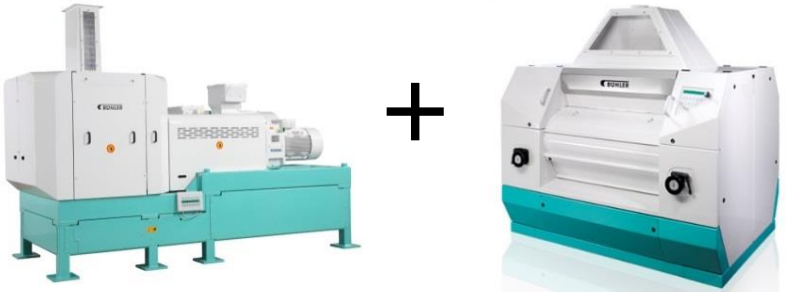
Traditional Atta Flour production by Stone, or Disc Mills

- Large amount of Atta Flour production in India is still made on an artisanal level
- Consumers buy wheat and grinds the wheat at home, or on small mills at the local markets
- Wheat is ground on Stone, or Disk Mills
- Flour is fresh consumed

Industrial Stone (Chakki) Mills

- Based on urbanization, consumers are buying branded Atta Flour, produced on an industrial level.
- Technology is based on Stone Mills, so called Chakki-Mills, often supported by one Roller Mill and Sifters.
- Capacity of the Mill is based on the amount of Chakki-Mills
- Branded Atta is sold mainly in small bags

PesaMill™ – Production of genuine Atta Flour.
Finished products produces with PesaMill™ Process.



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100% Wheat

PesaMill

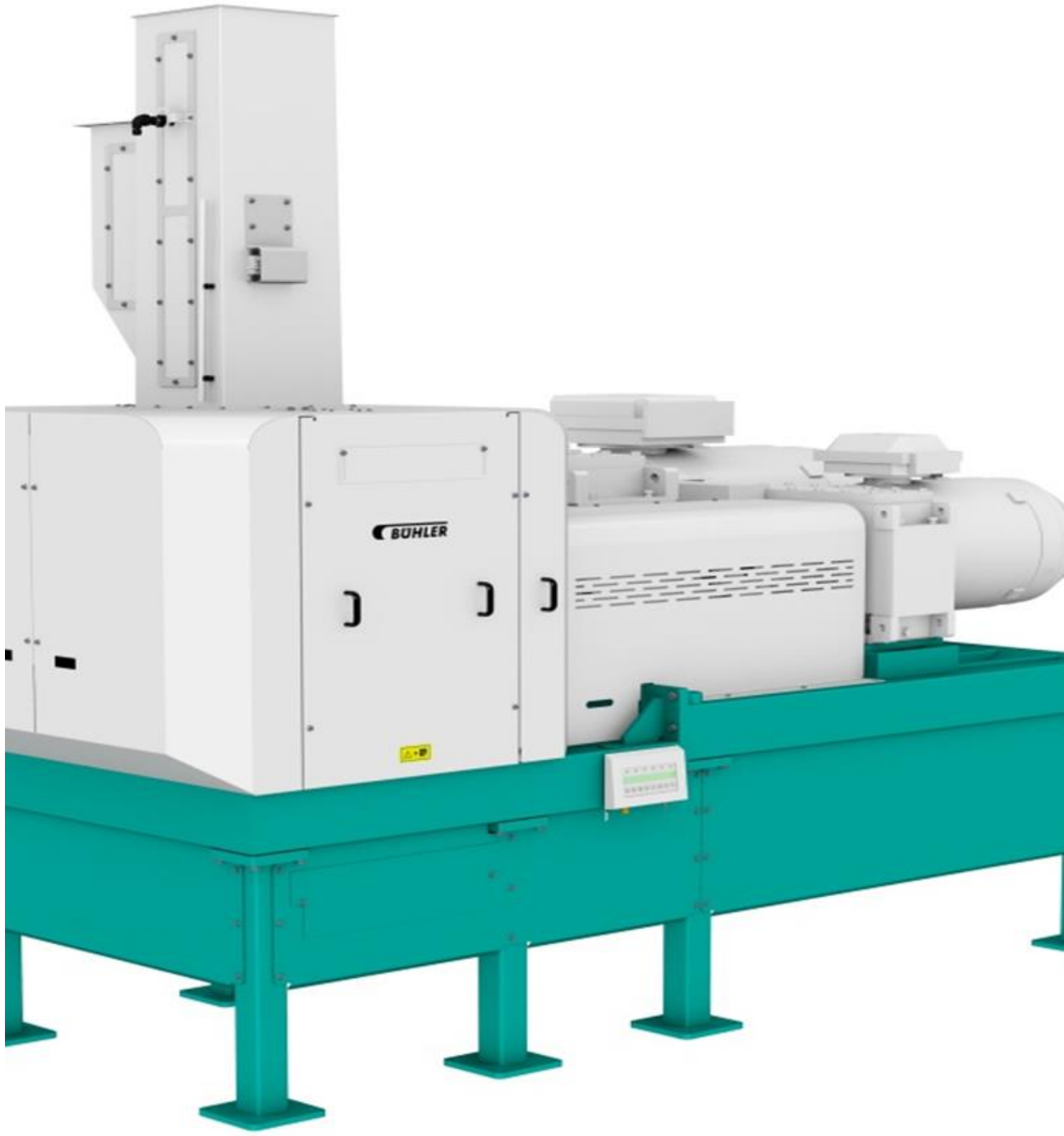
92% - 97% WW-Flour

0-7% Bran

PesaMill™

PesaMill™

- High-compression mill
- Pesa is a Sanskrit word for grinding
- Industrial equipment with high sanitation standards
- No product contamination with stone and binder (chemicals)
- Process flexibility:
  - Adjustment and control of starch damage and water absorption
  - Ability to produce various different types of Atta flours



AlPesa™ Milling System.

MDGM.

AlPesa™ Milling System
Technical specification

- The AlPesa™ milling system is a downscale of high-compression PesaMill™ technology.
- Flour characteristics such as starch damage and water absorption can be adjusted.
- Capacity: 700 – 750 kg/h.
- Energy consumption: 70kWh per ton.
- Modules: Feeding, Grinding, Sifting, Pneumatic transport, Filter and Automation.

Summery of Atta Flour

- To produce flour for Chappati, Roti and Puri only certain technologies can be used.
  - Stone grinding (Chakki Mills)
  - Disk Mills
  - PesaMill™ / AlPesa™

- The flour characteristic with high water absorption can only be used for flat bread.

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