Maize Process and Fortification

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Leader Grain Milling Flour Services
Integrated Solutions in Maize Fortification.

Outline

- Maize Market Relevance
- Maize Milling Process
- Key Machines
- Dosing Units
- Mixing
- Conclusions
The Bühler Core.
Processing of foods, feeds and advanced materials.
Bühler at a glance.

Global market leader with a strong presence in local markets

- **CHF 2,4 bn** Turnover
- **140** Countries
- **90** Service stations
- **27** Manufacturing sites
- **10,800** Employees
- **100%** Family-owned company
- Up to **5%** of turnover are invested in Research & Development
- Particularly committed to sustainability
About 175 million tons of maize are destined yearly to food applications.

2/3 of this consumption is realized in 13 countries.

Note: 2013 (estimated) data.
Source: FAOSTAT Balance sheets.
Maize Market Relevance.
About 175 million tons of Maize destined to Food Worldwide

North America 30%
- USA 30.1
- Mexico 16.1
- Canada 2.1
- Guatemala 1.6
- El Salvador 0.5

Europe 8%
- France 2.1
- Germany 1.4
- Ukraine 1.1
- UK 1.0
- Romania 0.9
- Italy 0.7

South America 7%
- Brazil 5.5
- Venezuela 2.0
- Colombia 1.6
- Argentina 1.0
- Peru 0.7

Middle East & Africa 30%
- South Africa 5.6
- Nigeria 5.7
- Egypt 5.6
- Ethiopia 4.1
- Kenya 3.5
- Tanzania 2.8
- Pakistan 2.7
- Malawi 2.2
- Zambia 1.7
- Zimbabwe 1.6

Asia 26%
- China 16.6
- Indonesia 8.2
- India 7.8
- Japan 3.6
- South Korea 2.2
- Philippines 1.6
- North Korea 1.5
- Nepal 1.2
- Vietnam 0.9
- Thailand 0.8

Countries with more than 0.5 million tons of corn destined to food per year.

Note: 2013 (estimated) data.
Source: FAOSTAT Balance sheets.
Maize Market Relevance.
MEA about 32 kg of maize consumed per capita per

about 104 million metric tons domestic supply of maize per year.

Top Maize Food Consumer (million tons)

<table>
<thead>
<tr>
<th>Country</th>
<th>Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>5.6</td>
</tr>
<tr>
<td>Nigeria</td>
<td>5.7</td>
</tr>
<tr>
<td>Egypt</td>
<td>5.6</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>4.1</td>
</tr>
<tr>
<td>Kenya</td>
<td>3.5</td>
</tr>
<tr>
<td>Tanzania</td>
<td>2.8</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2.7</td>
</tr>
<tr>
<td>Malawi</td>
<td>2.2</td>
</tr>
<tr>
<td>Zambia</td>
<td>1.7</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Per Capita Maize Consumption and Percentage Daily Energy Intake from Maize in Selected Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption (gms/day)</th>
<th>% energy intake of maize</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>192</td>
<td>31%</td>
</tr>
<tr>
<td>Uganda</td>
<td>161</td>
<td>15%</td>
</tr>
<tr>
<td>Tanzania</td>
<td>204</td>
<td>23%</td>
</tr>
<tr>
<td>Zambia</td>
<td>386</td>
<td>51%</td>
</tr>
<tr>
<td>Malawi</td>
<td>482</td>
<td>45%</td>
</tr>
</tbody>
</table>
## Maize Kernel. Constituents

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Amount Fat</th>
<th>Fat Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pericarp / Testa</td>
<td>6.0%</td>
<td>0.89%</td>
</tr>
<tr>
<td>Aleurone</td>
<td>7.0%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Glassy Endosperm</td>
<td>51.0%</td>
<td>0.24%</td>
</tr>
<tr>
<td>Floury Endosperm</td>
<td>23.0%</td>
<td>0.24%</td>
</tr>
<tr>
<td>Germ</td>
<td>11.5%</td>
<td>34.8%</td>
</tr>
<tr>
<td>Cap</td>
<td>1.5%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

*Amount Fat* | *Fat Percentage* | 

*Information: Hopkins, Smith + East*
Maize Variety.
Classification

Maize classification data pool

- Brazil, dent
- South Africa, white corn
- Romania, soft
- Italy, Flint
- US-Yellow II
- Americano, white corn
- Argentina, Plata
- Brazil, Mato Grosso
- France, soft

Maize Variety Classification

Bühler 2016 | Maize Processing Technology - Fortification
Maize Milling Core Process.
Cleaning concept for Aflatoxin Reduction

Use of Concentrator: Mostly for separation of cobs for prod. of flaking grits.
Maize Milling Core Process Roller Mill.
De-germination for hard maize (corn)

MHXM-MH, slotted sieve, square sieve jacket for hard corn

Flaking, brewery, snack grits corn flour and germ meal
Maize Milling Core Process.
Compact Mill - Hammer Mill

Maize degemerminator MHXM

Flowbalancer MZAH

Dampening

Magnet MMUA

cyclone MGXD

cyclone MGXD

cyclone MGXD

aspiration channel MVSG

hammer mill DNZF

drum sieve MKZM

germ meal

Endosperm < 1 % fat
e.g. for breweries, starch plants and alcohol prod. plants

hulls
Integrated Solutions in Maize Fortification.
Micro-feeder with conveyer

Location of feeder on flour collection conveyer. Adequate Mixing - at the front half of collection conveyer above the blades of the mixing screw. At least 3 meters of conveyer length is normally needed to ensure adequate blending.

Another option for feeder location: If it would be difficult to install the feeder at the beginning of a conveyer, the feeder can be connected to the flour discharge spout of a plan sifter.

Micro-feeder fitted above mixing conveyer.
Mills generally need one feeder per flour or meal line to be fortified. Larger Milling units with multiple products may require additional feeders including spares.

Feeders used for flour fortification need to deliver only relatively small amounts of material.

Hopper size on the feeder is also an important consideration, since you do not want to fill it constantly.
Integrated Solutions in Maize Fortification.
Procurement and Installation Micro-feeder system

This is done after technical evaluation of the production/milling systems and capacity of the streams.

Feeders should be set up with an electrical interlock system that prevents the flow of premix when flour flow is stopped.

An interlock causes the feeder to stop if the flour collection conveyor stops.

This will prevent the inadvertent over-Food Fortification of the flour, if there is a mechanical breakdown in the Mill.

An alternative approach is to have an automatic shut off switch on the feeder that is hooked up to a flour flow indicator or a pressure indicator in a pneumatic system.
## Integrated Solutions in Maize Fortification.

### Micro-feeder Versions and Applications

<table>
<thead>
<tr>
<th>Type</th>
<th>S/1-Typ (Performance Line) MSDC / MZMC</th>
<th>S-Typ (Top Line) MSDF / MZMO</th>
<th>R-Typ (Top Line) MSDF / MZMO</th>
<th>A-Typ (Top Line) MSDF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>0.75 – 127 l/h</td>
<td>0.75 – 500 l/h</td>
<td>0.75 - 2’000 l/h</td>
<td>0.75 - 9’000 l/h</td>
</tr>
<tr>
<td><strong>Screw ø</strong></td>
<td>20/32</td>
<td></td>
<td>20/32/65</td>
<td></td>
</tr>
<tr>
<td><strong>Double screw</strong></td>
<td>No</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Gravimetric</strong></td>
<td>Yes</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>Volumetric</strong></td>
<td>Yes</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>Non-free flowing bulk materials</strong></td>
<td>No</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>perfect</td>
<td></td>
<td></td>
<td>excellent</td>
</tr>
<tr>
<td><strong>Servo drive</strong></td>
<td>No</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Variability proportioning range</strong></td>
<td>1 to 20</td>
<td></td>
<td></td>
<td>1 to 100</td>
</tr>
<tr>
<td><strong>Refilling manually</strong></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Refilling with screw</strong></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cleaning door</strong></td>
<td>No</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>50%</td>
<td>100%</td>
<td>150%</td>
<td>200%</td>
</tr>
</tbody>
</table>
Integrated Solutions in Maize Fortification.
Micro-feeder mechanical principles

**Gravimetric feeding**
- Accurate gravimetric feeding of continuous product stream or small batch.
- very precise, accurate dosage.
- Traceability for food safety.

**Volumetric feeding**
- for constant volumetric feeding of micro components.
- very easy to use.
- cost-effective alternative.

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**Gravimetric Addition:**
Gravimetric addition involves measuring the weight of material to be added on a continuous basis. All feeders can be made into “loss in weight” feeders. The rate at which this weight drops with time indicates the true addition rate.

**Volumetric Addition:**
Volumetric addition is similar to using a cup or spoon to measure out ingredients. This is based on the principle that the volume of the material being added has a set weight when handled in a uniform manner.
Integrated Solutions in Maize Fortification.
Micro-feeder Versions S-Typ (Standard)

- For free flowing bulk materials

**Performance Line**

- MSDC-S/1
- MZMC-S/1
- (S/1 = SINGLE SCREW)

Typical Products:
- Malt flour
- Gluten
- Grits
- Maize meal

**Top Line**

- MSDF-S
- MZMO-S
- (S=STANDARD)

Typical Products:
- Malt flour
- Gluten
- Grits
- Maize meal

- Single Screw
- Screw-Ø 20/32 mm
- 0.75 – 127 Liter/h
- limited number of options

- Double Screw
- Screw-Ø 20/32 mm
- 0.75 – 500 Liter/h
- extensive number of options
# Integrated Solutions in Maize Fortification. Micro-feeder Screw Configuration (Capacity range)

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity range (dm³/h)</th>
<th>Belt set (°)</th>
<th>36:15</th>
<th>54:18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>36:36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MZMC - 20/1</td>
<td>0.75 – 12.7</td>
<td>0.94 – 25.3</td>
<td>1.40 – 37.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.75 – 6.8</td>
<td>0.75 – 13.1</td>
<td>0.80 – 19.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.75 – 3.1</td>
<td>0.75 – 6.2</td>
<td>0.75 – 8.9</td>
<td></td>
</tr>
<tr>
<td>MSDC - 20/1</td>
<td>0.75 – 12.4</td>
<td>0.94 – 24.6</td>
<td>1.40 – 36.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.75 – 6.5</td>
<td>0.75 – 12.7</td>
<td>0.80 – 19.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.75 – 3.0</td>
<td>0.75 – 5.9</td>
<td>0.75 – 8.5</td>
<td></td>
</tr>
<tr>
<td>MZMC - 32/1</td>
<td>3.3 – 84.2</td>
<td>6.6 – 164</td>
<td>9.5 – 239</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.7 – 39.8</td>
<td>3.0 – 76.9</td>
<td>4.7 – 114</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.75 – 18.0</td>
<td>1.4 – 35.0</td>
<td>2.1 – 50</td>
<td></td>
</tr>
<tr>
<td>MSDC - 32/1</td>
<td>3.6 – 80.7</td>
<td>6.6 – 155</td>
<td>9.3 – 228</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.7 – 38.3</td>
<td>3.4 – 73.9</td>
<td>5.1 – 108</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.75 – 17.0</td>
<td>1.6 – 33.0</td>
<td>2.3 – 48</td>
<td></td>
</tr>
</tbody>
</table>

³ Product-dependent approximate values  
⁴ Belt pulley of reel and twin screw can be exchanged
Conclusions.
To get it right – meet nutritional requirements

- Proper Assessment at the mill in terms of capacity of the streams and flow.
- Evaluation of the micro-feeders.
- Choosing the right screw configuration.
- Design and layout of the conveyors.
- Commissioning - installation of the feeders.
- Quality Check.
- Training and Education.
Training at African Milling School.
To get it right

- In Milling Processes
- Grain and Flour Quality Assessment.
- Flour Quality Improvement.
- Fortifications Solutions (DEMO).
- Baking Training.

Located in Nairobi, Kenya
Nairobi is a central business hub for East Africa and is the ideal location for the AMS, situated just 25 minutes from Nairobi’s international airport.

Training for all skill levels
African Milling School (AMS) for Junior, Advanced and Head Millers / Superintendants.
Swiss Milling School (SMS), Deutsche Müllerschule Brunswick (DMSB) and Kansas State University (KSU) for higher education degree.
Sustainability.
Bühler Isigayo.
Compact Maize Mill with lower capacity (intake 2 tons per hour)

Isigayo Compact Maize Mill – Compact maize mill requiring minimum investment.
- Pre-assembled maize mill
- High quality maize flour
- Reliable processing
- High yield