CEREAL TECHNOLOGY –
grain cleaning & milling

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CEREAL TECHNOLOGY – flour processing

Main parts of flour processing:
• grain mass cleaning
• grain milling and sieving
• commercial flours mixing
• quality standardisation
Main objectives of grain cleaning:

- to separate the grain from organic and mineral impurities, ferromagnetic components
- to remove parts of bran from grain endosperm
- to moistening the grain mass for reduce adhesion between bran and endosperm
- to standardisation of grain moisture before milling
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Wheat cleaners:

For organic impurities

For mineral impurities
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Bran removing machine
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Water content regulation - basic procedure before milling

Moistening machine

Automatic regulation of moisture level before and after moistening
Moisture level recommended for different wheat

<table>
<thead>
<tr>
<th>Wheat type</th>
<th>Moisture %</th>
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<tbody>
<tr>
<td>Extremally hard (Manit., dur.)</td>
<td>16,5 – 17,5</td>
</tr>
<tr>
<td>Americ. Bakery hard (HRW)</td>
<td>15,5 – 16,5</td>
</tr>
<tr>
<td>American (Austral.) soft</td>
<td>15,5 – 16,0</td>
</tr>
<tr>
<td>Traditional Soft European</td>
<td>15,0 – 16,0</td>
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Two main objectives of wheat milling:
• to separate endosperm of the grain from bran and germ
• to reduce dimensions of endosperm particles for fine flour particles

Fine flour - particles passing through the sieve with the rectangular apertures 140 µm in side

Middle Europe – mainly Czech
Austria – also coarser flours
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- Basic processing unit in modern flour mill:
  - Desintegration (prevailing grinding between two rollers)
  - Sifting (classification on plain sifters)
  - Resulting many fractions by particle size, lead to other passage steps – gradual size reduction

- Single processing unit → passage (grinding + sifting)
- A total milling scheme – many repeated process units
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A total milling process –

a complex scheme of passages

• wheat mill  15 – 20 passages
• rye mill  7 – 10 passages
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Traditional stone mill with two rounded stones (upper rotating – “runner“, lower stationary – „under runner“)
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A view of old milling stones
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- A scheme of a kernel between milling cylinders in roller mill.
- \( s \) – nip (narrow gap)
- \( z \) – a zone of active grain sheering and pressing
- \( d \) – fed particle diameter
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A scheme of roller mill – two units in one machine
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Roller machine in flour mill
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Milling rollers
- rollers for the several first steps – breaking - grooved on the surface)
- roller for several next steps – reduction - smooth surface
Main stages of milling on the rolls:

- **Breaking stages** (grain is opened mainly by sheared resulting coarse parts of grain, small part of endosperm as pure semolina, very small amount of flour), usually 4 – 5 breakings
- **Reduction stages** (intensive extraction of all resting parts of endosperm and finally also aleurone layer between smooth surface of reduction rollers)
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Plansifter - incorporating the sieves to the machine
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A sieve and the bottom used in plansifter
(a complex assemble if sieves is incorporated to plansifter allowing to collect single fractions as “oversieve“ or “undersieve“)
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A battery of plansifters in sieving boxes
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- Purifying – clean of semolina passages
- Between breaking stages → some parts of bran with adhered endosperm - the same dimension as pure semolina
- Not separable by sieves of plansifter
- Separated using air aspiration (effect of different specific gravity)
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Scheme of purifier
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Current type of wheat purifier
Automation of flour milling control

• In traditional mill control a ash content in single streams of grind was decisive

• Streams were regulated by setting of gap between rollers, different sieves and the diagram in total scheme if stages

• In modern mill setting of rollers and streams is standard and control with the computers is based mainly on standard streams in single stages (ash content is decisive too)
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Fine flour - particles passing through the sieve with the rectangular apertures 140 µm in side

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Commercial flours

- Flour is obtained in every step of breaking, reduction and purification in different percentages.
- Ash content and color are changing (first breakings lighter, low ash, last reductions dark and high ash)
- Commercial flours for distribution have prescribed ash content, resulting flour has to be mixed from single stages to fulfill it
Classification of commercial flours

- Usual professional international:
- T XXX (XXX ash content in % times 1000)
- E.g. T 550 (ash 0.55 % ±declination by local standard)
- Czech wheat type: T530, T600, T700, T1050

- Market classification different in countries
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Analytical methods for determination of level:
• Moisture, ash, protein, gluten, Falling number, sedimentation value

Rheological methods:
• Farinograph, extensigraph, alveograph, amylograph
• Fermentograph, maturograph, spring oven test

Milling and baking laboratory tests