CEREAL TECHNOLOGY –
grain cleaning & flour milling

Assoc. Prof. Marie Hrušková PhD.
Dept. of Carbohydrate and Cereals
Prague Inst. of Chem. Technology
Marie.Hruskova@vscht.cz
Technological procedure

- for-cleaning and storage
- grain cleaning
- grain milling
- processing flours mixing
- comercial flour packing and expedition
Grain cleaning procedure

- Removing of non-grain parts (mineral and organic impurities, stones, fero materials)

- Mechanical cleaning of grain surface

- Hydrotermic operation

- Moisture increase before milling
Black cleaning stage

- Aim – remove of all impurities from grain mass

- **Principal sorting**: grain form and space aerodynamic characteristics, specific weight, ferromagnetic features, optic differences
Mechanical cleaning of grain surface

☐ Aim – remove of all impurities from surface
   remove of inner grain part

☐ Principal – mechanical form
   brushing and aering of dust
Grain moistening before milling process

Moisture recommended for different wheats before milling

<table>
<thead>
<tr>
<th>Wheat type</th>
<th>Moisture %</th>
</tr>
</thead>
<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>
</tr>
</tbody>
</table>
Scheme of cleaning procedure for wheat
Mill cleaning part
Main objectives of flour milling:

- To separate endosperm of the grain from bran and germ
- To reduce dimensions of endosperm particles for fine flour particles

Fine flour - described as flour particles passing through the sieve with the rectangular apertures 140 μm in side
Grain milling = desintegration
physical and mechanical processig

- Aim- obtain of endosperm part removed from bran in semolina form (not fine flour)

- Differences for wheat and rye milling
  Differences of Czech technology
  wheat semolina and many forms of flour

Basic technics in industrial mill

*roll machine*

*planisifter*

*purifier*
CEREAL TECHNOLOGY – milling

Old milling stones
Traditional stone mill
- two rounded stones
  upper rotating – “runner“,
  lower stationary – „under runner“
CEREAL TECHNOLOGY – milling

A scheme of roller mill
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
CEREAL TECHNOLOGY – milling

A total flour milling process –
a complex scheme of passages

- wheat mill  15 – 20  grinding + sifting
- rye mill    7 – 10  grinding + sifting
CEREAL TECHNOLOGY – milling

A scheme of roller mill
CEREAL TECHNOLOGY – milling

- 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
Kinetic parameters of roller mill

Different speeds of two rollers expressed as a ratio of rotations

Fast speed:slow speed = 2.5 : 1
CEREAL TECHNOLOGY – milling

Milling rollers
first steps - breaking
grooved on the surface
last steps - reducing
smooth on the surface
CEREAL TECHNOLOGY – milling

Roller mills in flour mill
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 among smooth surface of reduction rollers), usually 6-8 reductions
CEREAL TECHNOLOGY – sifting

- Sifting process - after each step of disintegration (breaking and reduction stages)
- Separate on system of sieves (single fractions collected as “oversieve“ or “undersieve“)
- Using rotation motion and sieve cleaning by brush system on solid bottom
- Fine flour products
- Planisifter with different sieves group
CEREAL TECHNOLOGY – sifting

A sieve and the bottom used in plansifter
CEREAL TECHNOLOGY – sifting

Incorporating the sieves to the plansifter
CEREAL TECHNOLOGY – sifting

A battery of plansifters in sieving boxes
CEREAL TECHNOLOGY – purifying

- Purifying of semolina products
- Between breaking stages → some parts of bran with adhered endosperm - the same dimension as pure semolina
- Not separable fraction by sieves on planisifter
- Separate using aspiration effect samples of different specific gravity
CEREAL TECHNOLOGY – purifying

Scheme of purifier
CEREAL TECHNOLOGY – purifying

Current 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)
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
- Commercial flours-tested on ash and particle diametres
Classification of commercial flours

- Usual professional symbol:
  - T XXX (XXX ash content in % times 1000)

- E.g. T 550 (ash 0.55 % ±declination by local standard)

- Market flour classification different in other countries