Technological methods of improvement and influence on the rotor rotation speed on efficiency of barley hushing machine

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Abstract. The article provides the results of a study of the impact of different parameters and the process of peeling barley in the production of feed. Theoretical studies and analysis of the structures of the peelers and the proposed horizontal peeler have suggested that the rational rotation rate of the rotor during barley peeling will be between 1500 and 1800 rpm. After the studies, a number of factors were tested which influenced and increased the efficiency of barley peeling, which determined the effect of rotor rotation frequency, processing duration, the amount of product passed through processing during the peeler. Based on the research, the technological parameters of the peeler have been developed and improved.

1 Introduction

Barley, grown in the dry and hot climate of our Republic, has its own individual quality features and differs in its physical and chemical composition, as well as mechanical and technological properties. Literary sources do not provide enough data on quality indicators and processing of barley cultivated in Uzbekistan.

The increase in the nutritional value of the barley grain is achieved by reducing the quantitative content of fiber in it. Reducing the fiber content is carried out by removing flower shells with preliminary flaking. In this regard, the state of the issue on the technology of the process of peeling barley grain is briefly considered.

Scientific developments in the field of feeding have now made it possible to widely use in feed for farm animals high-yield crops of cereals and legumes, promising hybrids, non-traditional raw materials. But the use of filmed grains in feeds has a number of drawbacks, as they contain film shells that need to be separated from the kernel of the grain.

The peeling of grain raw materials in the production of feed is one of the most important technological operations, largely determining the quality of finished products. The degree of peeling of grain feed components significantly affects their quality and digestibility.

Currently, there are a number of machines for peeling grain. There are three ways of peeling or the principles of mechanical impact of working organs on the grain, necessary for the destruction and removal of shells [1, 3, 5].

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The first method – compression with a shift - is effective for grain, which shells have not fused with the core (millet, buckwheat, oats). The main machines using this method are a husk, a valcedek machine and a husk with cropped swaths.

The second method – peeling multiple or single blow – is used for grain with a strong core and unsupfused films (oats), which is not crushed on impact, or when receiving crushed number grit from grain, which films are firmly fused with the core (wheat, barley, etc.). The peeling is recommended for oats once, it is carried out in a centrifugal husk. Multiple strikes are used for barley, wheat, corn for this purpose pest and decal machines.

The third method of peeling is the gradual erasure (scraping) of the shells as a result of friction of the grain on the moving rough surfaces. This method is used for the peeling of grain, in which the films are densely fused with the core (barley, wheat, corn, peas).

The Kazan GAU has developed flacronic machine designs based on a complex shock-inertial and aerodynamic method of impact on the grain, called the pneumatic method. The degree of peeling of feed grain components significantly affects their quality and digestibility.

The method proposed in the work provides for the impact on the processed product by flak in the disk and saw-shaped surfaces. The study of the peeling process boils down to the analysis of the main factors that ensure the removal of the outer shell of grains in different ways of influencing their impact on the quality indicators of the peeling process, as well as to the definition of the power and performance of the peeling machines.

However, the task is to improve and improve the peeling process of cereals. After studying the problem, equipment and technology and peeling, our goal was to improve and improve the peeling process of cereals on the peeling machines.

The technological effect of the peeling process can be established after determining the amount of grain peeled on this system and the number of whole kernels obtained. A number of authors considered peeling grain from the position of a system of approach. They proposed analytical formulas to determine the power to move the entire flow of the grain mixture in the next form.

\[
N = nQ \cdot R - r \cdot w \cdot \omega
\]

where:
- \( Q \) is the performance of the peeling machine, kg / s;
- \( n \) - number of discs in the rotor, pcs;
- \( R \) is the radius of the disk, m;
- \( r \) is the radius of the shaft, m;
- \( w \) is the angular velocity of the disks, \( s^{-1} \).

And when calculating the power consumed by a husky machine with cropped rolls has a formula:

\[
N = \frac{fE \sqrt{h \cdot d}}{(\mu - 1)} \cdot D \cdot \left( \omega \cdot \omega_b \right) \cdot \frac{d}{d}
\]

where:
- \( f \) - coefficient of friction of grain on the working surface;
- \( E \) - longitudinal modulus of elasticity of the working surface, N/mm²;
- \( h \) is the value of the absolute deformation, mm;
- \( \omega \) - angular velocity of grain, \( s^{-1} \);
- \( D \) - roll diameter, mm;
- \( \omega_b \) - angular speed of a rapidly rotating drum, \( s^{-1} \);
- \( \mu \) - Poisson's ratio of the working surface;
- \( d \) is the average diameter of the wheat, mm.

2 Experimental research technique
will go to the processing by random selection from different places selected three hangings mass each. Then each canopy was laid separately from the rest on a white surface. Using a magnifying device in each of the three awnings, each grain was considered separately, and its assessment was given in terms of the degree of peeling: if the surface of the grain is more than on. was released from the shells, then such grain was considered flak, otherwise - not flak. Based on the data obtained after the study of all three awnings, the average result is determined by the number of non-flaked grains in the batch of barley before peeling, expressed in percentage. The same actions are carried out with the same party after peeling.

2.1 The technique for determining the performance of a peeler

The following technique was used to determine the performance of the laboratory peeler during the pilot work. After a few seconds after the grain starts to flow into the peeler, the machine's mode of operation comes, i.e. the mode in which the grain flow moves evenly in the working area of the peeler. The stopwatch then measures a certain time interval in the process of when the peeler is operating in a set mode. To obtain more reliable results of the experiment, different time intervals of peeling are consistently measured. The peeling products obtained over a certain period of time, which include both exfoliated grain, and peeling waste, are then weighed. The waste leaves the shell, the flour and the crusher. The average performance of the flaker is determined by the ratio of the mass of peeling products to the processing time.

3 Study results

The work used barley humidity 13%, grown in Uzbekistan which was added to feed in flaky and not flaky form in the number of recipes selected. Experimental research to determine the effect of the husk peeling capacity on the flaker efficiency and the content of broken barley grains

Table 1. Peeling factor and the content of broken barley grains at different flaky performance

<table>
<thead>
<tr>
<th>Experience No.</th>
<th>Flake performance, kg/h</th>
<th>Barley peeling ratio, %</th>
<th>Broken barley grains, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>180</td>
<td>68</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>43</td>
<td>1</td>
</tr>
</tbody>
</table>

3.1 Study the effect of rotor rotation and performance on the efficiency of the flach

Our studies of horizontal flaking have suggested that the rational rotation rate of the rotor when barley flakes will range from 1,500 to 1,800 rpm.
Table 2. Barley peeling ratio at different performance and rotor rotation rate

<table>
<thead>
<tr>
<th>Flach frequency, rpm</th>
<th>Performance of the peeler, kg/h</th>
<th>Barley peeling ratio, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>150</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>200</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>1650</td>
<td></td>
<td>88</td>
</tr>
<tr>
<td>1800</td>
<td></td>
<td>93</td>
</tr>
</tbody>
</table>

As you can see from the table, with a rotational frequency of 1500 rpm (in performance ranges of 180 kg/h or below), the efficiency of the process is less than 70%, and 1650 and 1800 rpm (in performance ranges of 280 kg/h and above) efficiency is below 50%. Therefore, the optimal technological effect of flaking occurs less frail performance.

Table 3. Peeling factor and the content of broken barley grains at different flake performance

<table>
<thead>
<tr>
<th>Frequency of rotation of the flanhorn rotor, rpm</th>
<th>Flake performance, kg/h</th>
<th>Peeling factor, %</th>
<th>Broken grains, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>6.25</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>1500</td>
<td>7.5</td>
<td>88</td>
<td>4</td>
</tr>
<tr>
<td>1500</td>
<td>8.3</td>
<td>43</td>
<td>1</td>
</tr>
<tr>
<td>1650</td>
<td>7.5</td>
<td>88</td>
<td>5</td>
</tr>
<tr>
<td>1650</td>
<td>9.3</td>
<td>46</td>
<td>3</td>
</tr>
<tr>
<td>1650</td>
<td>11.2</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>1800</td>
<td>7.0</td>
<td>93</td>
<td>8.1</td>
</tr>
<tr>
<td>1800</td>
<td>10.1</td>
<td>70</td>
<td>8.0</td>
</tr>
<tr>
<td>1800</td>
<td>10.8</td>
<td>59</td>
<td>4.9</td>
</tr>
</tbody>
</table>

As you can see from the table, the best flaking factor is achieved at 1800 rpm and 7 kg/h performance is 93%, the number of broken grains of barley at these parameters was 8.1%. Comparable to the current 8 machines (in the peeling machine A1-SHN-3 the number of broken grains is more than 10%, the wallpaper machine R3-BGO-8 more than 15%).

Table 4. Efficiency, power consumption and flaky performance values depending on the humidity of the barley grain

<table>
<thead>
<tr>
<th>Humidity barley, %</th>
<th>Performance of peeling, kg/h</th>
<th>Peeling factor, %</th>
<th>Frequency of rotation of the flanhorn rotor, rpm</th>
<th>Power consumption, kWh/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>6.5</td>
<td>90</td>
<td>1500</td>
<td>0.016</td>
</tr>
<tr>
<td>13</td>
<td>6.5</td>
<td>90</td>
<td>1500</td>
<td>0.014</td>
</tr>
<tr>
<td>13</td>
<td>7.0</td>
<td>93</td>
<td>1800</td>
<td>0.0105</td>
</tr>
</tbody>
</table>
4 Conclusion

Experiments showed that with a humidity of 13%, a performance of 7 kg/h and a rotation rate of 1800 rpm, the specific electricity consumption was minimal. [7,8,9]

References

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