THE MAIN PHYSICAL AND MECHANICAL CHARACTERISTICS OF FINISHED PRODUCTS WITH GRINDING OF ANNUAL PLANTS NO-KNIFE

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Despite the large volume of use of wood fiber in the production of finished products in pulp and paper production, the consumption of the latter is significantly increasing. To reduce the consumption of fibrous raw materials from wood, it is advisable to use annual plants for these purposes, among which the use of technical hemp is most common. This is due to the positive features of the physical and mechanical characteristics of the finished product obtained from technical hemp. This is especially important when using a non-knife method of grinding semi-finished products from technical hemp.
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Paper production is heavily dependent on the grinding process, which plays a crucial role in determining the key properties of paper.

First of all, non-milled fibers lead to low-quality sheets of paper and limited fiber flexibility. In addition, insufficient hydration of non-milled fibers hinders their ability to effectively integrate into the structure of the paper sheet. Although the main purpose of grinding is not to shorten the fibers, it is primarily aimed at splitting the fibers into fibrils along their length. This process increases the flexibility, plasticity and swelling of the fibers, which ultimately leads to improved adhesion of the fibers. Fiber adhesion is a vital characteristic that determines the mechanical strength and absorbency of a paper sheet.

In the field of fiber processing, there are various methods using mechanical or hydrodynamic effects. During the grinding process, the fibers are cut, crushed, combed and divided into bundles of fibers.

When using knife machines for grinding fibrous semi-finished products, certain problems may arise during secondary grinding and when working with short-fiber wood, especially hardwoods. To overcome these difficulties, it is recommended to use the grinding method without using a knife. One of such methods is the experimental installation "Jet-barrier", which is used at the Department of Machines and Devices of Industrial Technologies at the Reshetnev Siberian State University of Science and Technology [1].

In a knife-less installation, the process of grinding fibrous materials is mainly carried out through a combination of several physical influences, which can be divided into four main groups. Firstly, there is a cavitation effect, in which cavitation bubbles form and collapse in a liquid medium, interacting with a fibrous material. Secondly, the pulsating effect is achieved due to the free flow of the suspension jet. Thirdly, the suspension jet acts on the barrier when in contact with the barrier. Fourth, the effect of hydrodynamic friction, which is caused by the viscosity and velocity gradient inside the liquid, which leads to the appearance of friction forces that contribute to grinding [2].

In recent years, there has been a growing tendency to use technical hemp as a raw material in pulp and paper production. The use of technical hemp in this industry provides a number of advantages, including its rapid growth, high cellulose content and minimal environmental impact. An additional advantage is that technical hemp can be grown without the use of pesticides or fertilizers, which makes it a more environmentally friendly alternative to traditional crops such as wood. Despite the fact that there are still certain problems associated with the processing and use of technical hemp for the production of paper and pulp, ongoing research and development in this area provides promising results for a more sustainable and environmentally friendly future. Hemp-based

paper has numerous advantages over traditional wood-based paper, such as increased tear resistance and excellent ink absorption [3].

At the initial stage of preparation, the bast part of hemp is crushed. This is necessary because hemp fibers are exceptionally long, reaching 2-4 meters in length, which makes it impractical to directly grind them using a knife-less installation. Therefore, the first stage involves a pre-grinding process to split the fibers into smaller fragments. In the mentioned study, a disintegrator-crusher, known as a "Record", was used for this purpose, facilitating the crushing of a hemp stalk [4].

Figure 1 shows the dependence of the degree of grinding of technical hemp on the grinding time for a non-knife installation "Jet-barrier" and for a centrifugal grinding plant (CGP). As can be seen from the figure, in both cases there is a significant increase in the degree of grinding from the grinding time, regardless of the type of grinding plant. As can be seen from the figure, the qualitative dependencies for the non-knife grinding method and for the CGP do not differ from each other and represent a parabola. As for the quantitative dependencies of the increase in the degree of grinding with the use of a knife-less installation, they have higher indicators compared to the use of a CRA. The difference between the grinding rates for these two plants is approximately 8%.

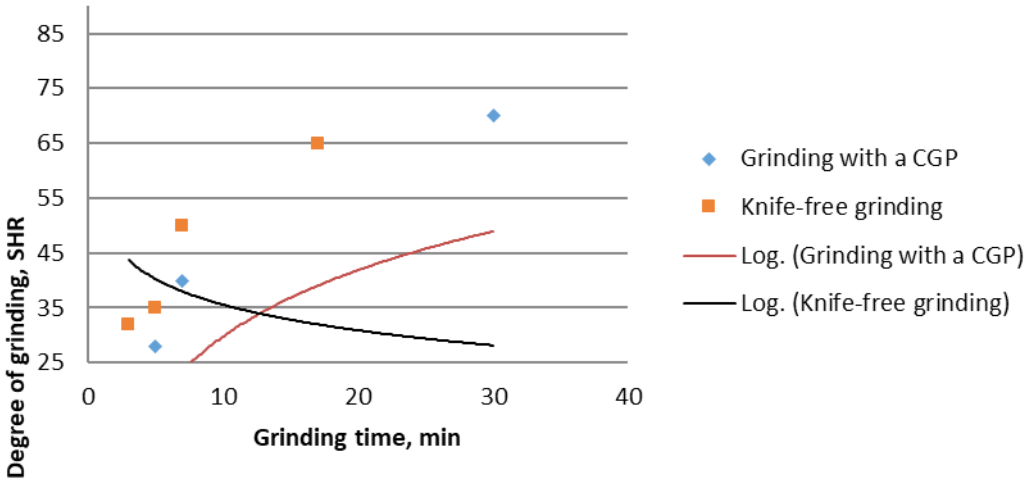

Figure 1 – The degree of grinding from time to time

The breaking length of a fiber is a comprehensive parameter that is obtained by multiplying the strength of a fiber by its metric number. This gives an idea of the strength of the interconnection of fiber-to-fiber links. A higher breaking length means a stronger bond between the fibers [5]. Figure 2 shows the dependence of the breaking length of finished products on the degree of grinding of the fibrous mass. It can be seen from the figure that for both installations the qualitative values of the magnitude are presented in the form of parabolas. As for quantitative values, when using a non-knife grinding method, the value of the breaking length is higher than when using a CGP.

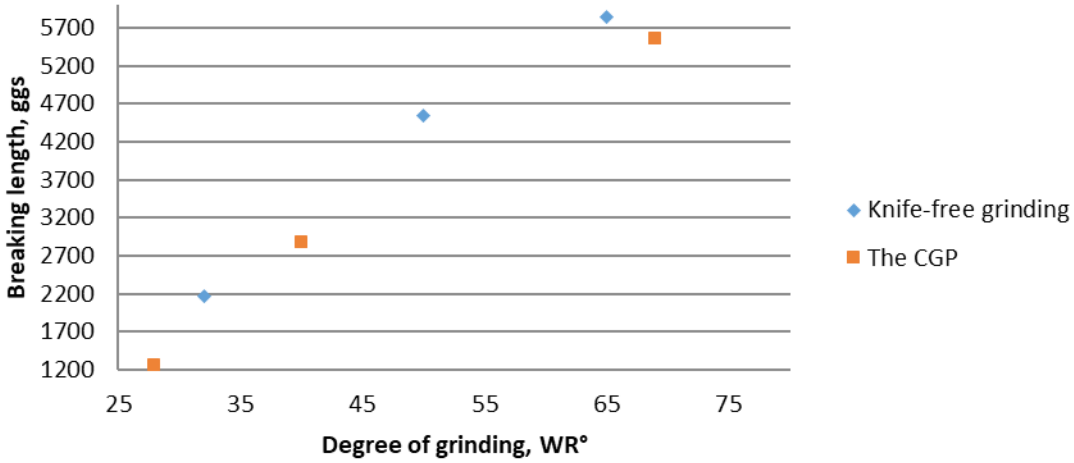

Figure 2 – Breaking length of technical hemp

Conclusions:

1. When using two methods of grinding fibrous mass from technical hemp, there is an increase in the indicators of the degree of grinding, water-holding capacity, fiber length from the degree of grinding, moreover, when using a non-knife grinding method, these indicators are higher than when using CGP.

2. Physical and mechanical parameters of finished products: the breaking length and the amount of penetration after grinding the mass in both cases, an increase in these indicators is observed. With a non-knife grinding method, the indicators of physical and mechanical characteristics are higher than when using CGP.

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