THE INFLUENCE OF THE FORCES OF THE REFINER DISK ON THE FRACTIONAL COMPOSITION OF THE FIBROUS SEMI-FINISHED PRODUCT

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This paper presents the results of experimental studies conducted under conditions as close as possible to industrial conditions for the process of refining a fibrous semi-finished product in the production of fiberboards, which allows us to evaluate the effectiveness of refiner disk for preparing wood fiber while regulating the forces created during the refining process.

Keywords: refiner disk, fibrillation, fibrous semi-finished product, refining, fractional composition.

In the production of panel materials, such as fiberboards, the refining process is the most important technological stage, as a result of which wood fibers are exposed to the refiner of in disk mills (defibrators and refiners) and acquire certain fractional composition and characteristics [1,2]. The design of the refining largely determines the forces exerted on the fibers during their processing, the regulation of which largely determines the size-quality characteristics and fractional composition of the resulting wood fiber semi-finished product [3-5]. The design of the headset for refining wood fibers, traditionally used in industry, has a double-sided design, which, according to the research of the authors [1-3], provides undesirable shortening of the fibers and, as a result, does not allow obtaining a semi-finished product with the required fractional composition, reducing the efficiency of disk mill, the physical and mechanical properties of the manufactured products.

Based on numerous theoretical and experimental studies [3], a fundamentally new design of a fibrillating refiner disk has been developed [3], which allows the destruction of wood fibers during their preparation mainly in the longitudinal direction due to the predominance of normal forces over tangential ones. According to studies [1-5], the predominant splitting of plant fibers in the longitudinal direction helps to preserve their natural length while reducing the diameter and increasing the proportion of formation of such fibers in the total mass, interfiber interaction improves, thereby ensuring high physical and mechanical properties of wood fiber materials.

Wood fiber after an RT-50 defibrator was used as the starting material (grinding degree DSd≈12 DS, average fiber length La≈6.5 mm, average fiber diameter da≈0.26 mm, La/ da≈25; coarse fraction content VKd2=40%; content of the middle fraction VSD2 = 38%; content of the fine fraction VMD2 = 22%), obtained from coniferous wood species (100%) at the plant for the production of fiberboards of Segezha Group OJSC "Lesosibirsk LDK No. 1". Studies of the grinding process of fibrous semi-finished products were carried out on a semi-industrial disc mill MD on the basis of the laboratory of the Department of MAPT Siberian State University named after. Reshetnev [3].

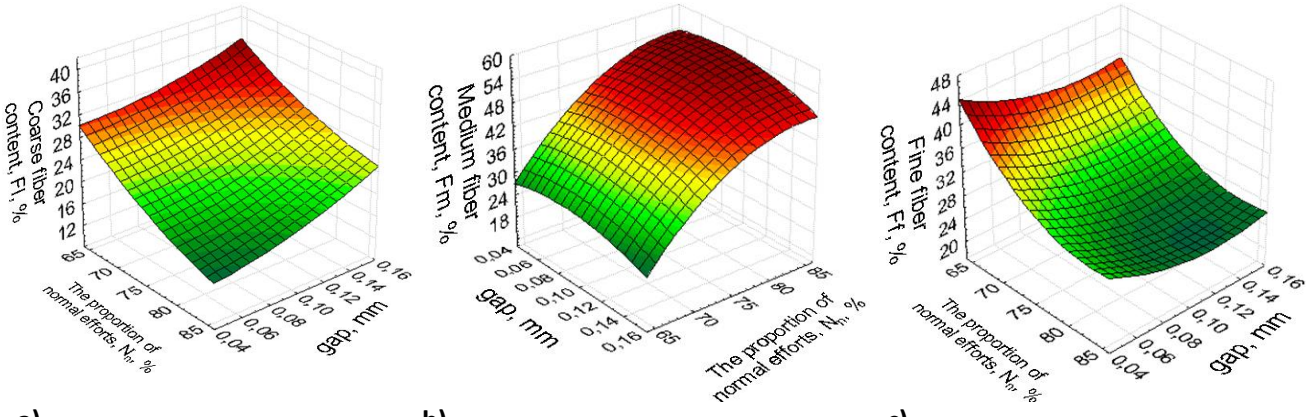
Based on numerous theoretical and experimental studies, according to well-known methods [3], the second stage was an experiment to evaluate the influence of the proportion of normal forces generated by the action of refiner disks and changing the gap between refiner diskes during the grinding process on the fractional composition of wood fibers. When planning and implementing experimental studies, refiner disk with design and technological parameters were used that provided a different proportion of normal forces when exposed to a fibrous semi-finished product (traditional design Nn≈65%, new design Nn≈75-85%).

During the implementation of a multifactorial experiment, after the process of refining wood fiber at the given parameters of the process under study, the fractional composition of the semi-finished product was assessed (Fl, Fm, Ff, %).

The assessment of the fractional composition of the wood-fiber semi-finished product was carried out using a FVG-2 fractionator device and a Hitachi TM-3000 digital microscope), according to well-known methods [3-5].

A graphical interpretation of the results establishing the pattern of changes in the fractional composition of the fibrous semi-finished product from the studied design and technological parameters of the refining process is presented in Figure 1.

The ratio of fiber fractions in the total mass of the semi-finished product characterizes its size-quality composition and the efficiency of the refining process, ensuring structure formation in the slab and, accordingly, its physical and mechanical properties.



a) b) c)

Figure 1 – Influence of the proportion of normal forces of the refining when adjusting the gap on the change in the fractional composition of the fibrous semi-finished product (a-c)

From the graphical dependencies shown in Figure 1, it is clear that with an increase in the gap (z), a decrease in the coarse (Fl) (Figure 1a) and an increase in the fine (Ff) (Figure 1c) fractions occurs less intensively, while the content of the proportion of fibers of the medium fraction (Fm) in the total mass of the semi-finished product (Figure 1b) increases when the working gap is ≈ 0.08-0.1 mm. An increase in the proportion of normal forces (Nn) entails a decrease in the coarse (Fl) fraction, intensive formation of the medium (Fm) fraction of fibers, while reducing the proportion of the fine fraction in the total mass of the semi-finished product, which confirms the predominant destruction of fibers in the longitudinal direction and their fibrillation. According to research [2, 5], the middle fraction consists predominantly of fairly long and thin, well-developed fibrillated fibers, which are responsible for bond formation in the slab. Accordingly, a decrease in the content of such fibers in the total mass of the semi-finished product worsens its quality. Their predominant content, in the presence of small fibers in the total mass of up to 40%, has a positive effect on the quality of the semi-finished product as a whole, and the strength properties of the slab are improved [5].

Thus, based on the analysis of the fractional composition of the semi-finished product, we can conclude that in order to improve its quality, it is necessary to influence the fibers during the refining process, which would allow increasing the content of medium fraction fibers in the total mass of the semi-finished product, with a sufficient content of the proportion of fine and coarse fractions [3.5]. With a gap (z) ≈ 0.08-0.1 mm and a mass concentration (c) ≈ 3% during the grinding process with an increase in the proportion of normal forces (Nn) ≈ 75 - 85%, when the refiner disk is exposed to wood fibers, their effective destruction of weak bonds in the longitudinal direction (fibrillation). As a result, in the total mass of the semi-finished product during the grinding process, the predominant formation of the medium (Fm) fraction of fibers occurs, indicating an increase in its quality.

Acknowledgments: The authors express their gratitude to the Centre for Collective Use of KSC SB RAS for supporting their research. This work was completed under the State Assignment issued by the Ministry of Education and Science of Russia for the project: “Technology and Equipment for the Plant Biomass Chemical Processing” by the Plant Material Deep Conversion Laboratory (Subject No. FEFE-2020-0016).

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