

EFFECT FREENESS OF WOOD FIBERS AFTER THE DEFIBRATOR ON THE PHYSICO-MECHANICAL PROPERTIES OF FIBER MATERIAL

A.Yu. Vititnev¹, Yu.D. Alashkevich¹, N.G. Chistova^{1,2}, V.N. Matygulina¹

¹ *Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, Russia*

² *Krasnoyarsk institute of railway transport, Krasnoyarsk, Russia*

This paper presents the results of studies of the process of refining the pulp in a refiner with the influence of freeness of wood fibers after the defibrator on the physicomachanical properties of the fiberboards.

Keywords: fiberboard, refiner disk, fibrillation, wood fiber, defibrator, physical and mechanical properties.

The process of grinding wood-fiber semi-finished product is one of the most important technological stages in the production of wood-fiber boards, as a result of which the fibers acquire dimensional and qualitative characteristics (degree of grinding, average length and diameter, their ratio, the ratio of various fractions in the total mass, etc.), which determine properties of the finished product. Grinding of wood fibers is carried out in disk mills (defibrators, refiners) in two stages [1, 2]. The efficiency of this process is influenced by many factors, such as the quality of the feedstock, the design of the grinding set, the working gap between the grinding discs, the concentration of wood pulp, etc.

In the course of numerous experimental studies [1, 3] of the process of grinding a fibrous semi-finished product, it was found that the degree of grinding of wood fiber after the first stage of grinding in a defibrator has a significant effect on the efficiency of further grinding at the second stage in a refiner. As the raw material under study, we used wood fiber after the primary grinding of technological chips on a defibrator RT-50, obtained from wood waste of mixed coniferous species composition (99 ± 1)%, mainly from Siberian pine. The raw materials were used by the fiberboard production plant of the Segezha group "Lesosibirskiy LDK No. 1".

Wood fiber with varying degrees of development after the defibrator (from 10 to 14 DS) was subjected to grinding, which corresponds to the range of fluctuations in the degree of grinding at the first stage of grinding in industrial conditions. The grinding process was carried out on the basis at the Laboratory of the Industrial Technology and Machine Engineering Department of Reshetnev Siberian State University in a semi-industrial disk mill MD with the use of the developed design of the set of fibrillating action, all other things being

equal for the production of fiberboard. The data in table 1 demonstrate the effect of the degree of grinding after the defibrator on the size and quality characteristics of the fibers of the semi-finished product. (grinding degree – DS, average fiber length - L_a , average fiber diameter - d_a , length to diameter ratio - L_a/d_a) with further grinding in a refiner at a concentration of wood pulp (c) = 3% and the size of the working gap between the refiner discs (g) = 0,1 mm.

Table 1. Changes in the size and quality characteristics of wood fibers in the process of refining

Grinding degree of wood fibers after defibrator, DSd	Dimensional and quality characteristics of wood fibers after the refiner			
	DS	L_a , mm	d_a , mm	L_a/d_a
10DS	19	3,9	0,053	78,5
12DS	20	4,3	0,046	93,3
14DS	17	3,7	0,087	44,5

Analyzing the data (Table 1), the degree of grinding of wood fibers after the defibrator has a significant effect on the rate of change in their geometric dimensions in the process of further grinding at the second stage. An increase in the degree of grinding after the defibrator over 12 DS entails a decrease in the intensity of development and fibrillation of fibers during their further processing, in general, the efficiency of the grinding process. This is due to the fact that an increase in the degree of grinding of wood fibers in the defibrator is accompanied by a significant change in their size (shortening), as a result of which the fibers are less prone to further processing, which limits the quality indicators of the semi-finished product and the formation of various fractions in the total mass, negatively affecting the bonding of fibers in the plate [2-4]. In fig. 1 shows the dependence of the physical and mechanical properties of fiberboard on the degree of grinding after the defibrator.

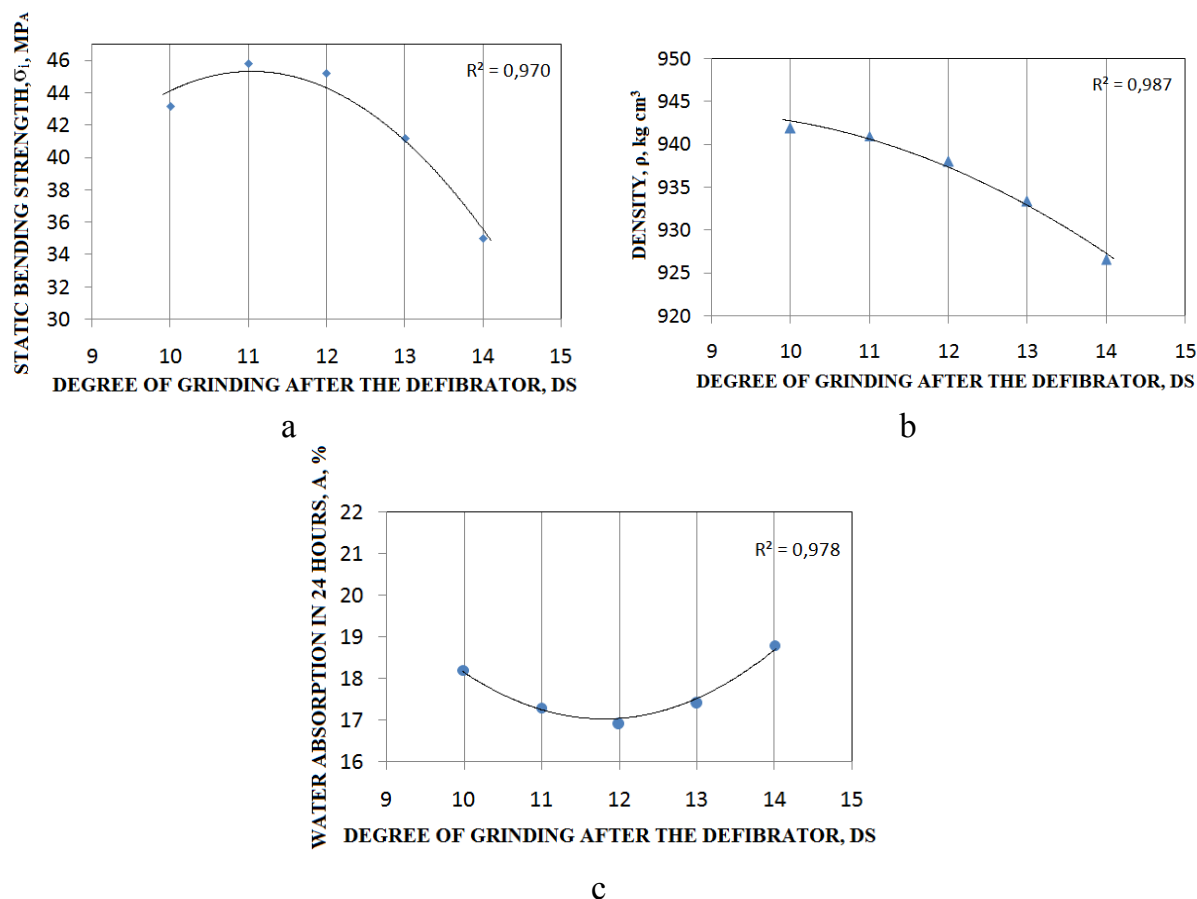


Fig. 1. Influence of the degree of grinding after the defibrator on the physical and mechanical properties of fiberboard: a - static bending strength; b - density; c - water absorption in 24 hours

Maintaining the degree of grinding of wood fibers after the defibrator within 11-12 DS provides an improvement in the physical and mechanical properties of the fiberboard, in particular, its strength $\sigma_i \approx 43\text{-}45.2$ MPa (Fig. 1), which is associated with the best dimensional and qualitative characteristics of the fibers of the semi-finished product achieved in the process of their secondary grinding [3-5].

Thus, the use of the new design of the headset allows, while maintaining the degree of grinding after the defibrator up to 12 DS, which is advisable due to the reduction in power consumption, the most efficient preparation of a fibrous semi-finished product at the second stage of grinding of the required quality, ensuring high strength properties of the board in accordance with the requirements of GOST 4596-2018 without using binder resins.

Acknowledgments: The authors express their gratitude to the Center for Collective Use of KSC SB RAS for supporting the research.

Funding: The research was carried out under the governmental task issued by the Ministry of Education and Science of Russia for the "Technology

and Equipment for the Chemical Processing of the Plant Biomass Material" project by the Deep Plant Material Processing Laboratory(FEFE-2020-0016).

References

Vititnev A. Yu. Sovershenstvovanie processa razmola voloknistyh polufabrikatov v proizvodstve drevesnovoloknistyh plit. Dis. cand. tehn. nauk. [Improvement of the process of grinding fiber semi-finished products in the production of wood fiber boards. Cand. techn. sci. diss]. Krasnojarsk, SibGU Publ., 2019, 152 p.

2 Chistova N. G. Pererabotka drevesnyh othodov v tehnologicheskom processe poluchenija drevesnovoloknistyh plit. Dis. dok. tehn. nauk. [Processing of wood waste in the technological process of obtaining wood fiber boards. Dr. techn. sci. diss]. Krasnojarsk, SibGTU Publ., 2010, 415 p.

3 Vititnev A.Yu., Alashkevich Yu.D., Chistova N.G., Marchenko R.A., Matygulina V.N. Khimiya Rastitel'nogo Syr'ya, 2020, no. 4, pp. 451–457. (in Russ.).

4 Matygulina V.N., Chistova N.G., Vititnev A.Yu. Khimiya Rastitel'nogo Syr'ya, 2020, no. 4, pp. 467–474. (in Russ.).

5 Alashkevich Yu. D., Kovalev V. I., Nabieva A. A. [Effect of the headset pattern on the process of grinding fibrous semi-finished products]. Monograph.2010, part 1, 168 p (In Russ.)