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COMPARATIVE PRODUCTION TEST RESULTS OF THE RECOMMENDED WOOL OPENING AND CLEANING MACHINE

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Аннотация. В статье проведены опытные испытания усовершенствованной машины для трепания и очистки шерсти на предприятии по первичной обработке шерсти. Первоначально были проанализированы результаты испытаний шерстяного сырья, очищаемого на существующей машине 2-БТ-150Ш, а также на предлагаемой машине для трепания и очистки шерсти.

Annotation. The article presents experimental tests of the improved wool opening and cleaning machine at a primary wool processing plant. Initially, the results of tests conducted on wool raw material cleaned with the existing 2-BT-150Sh machine and with the proposed opening and cleaning machine were analyzed.

Ключевые слова: электронный динамометр, модальная масса, подвижная сила, микроскоп, окуляр, оптимальный параметр, минерал

Keywords: electronic dynamometer, modal mass, mobile force, microscope, eyepiece (ocular), optimal parameter, mineral

Introduction. In the primary processing of wool, which is one of the important branches of the light industry, ensuring the quality of raw materials and turning them into high value-added products is one of the urgent issues today. The quality indicators of wool fibers — including their length, cleanliness, and uniformity — are the main factors determining the quality and competitiveness of the final product. Therefore, much attention is being paid to improving the existing technologies used in the initial processing of fibers.

At the same time, the regulatory and legal documents adopted in this field also play an important role. In particular, Presidential Decree No. PQ–4563 of January 10, 2020, defines measures for the further development of the light and textile industry, providing for the introduction of modern technologies in enterprises, the development and testing of new machines and equipment. In addition, the Strategy for the Development of the Light Industry of the Republic of Uzbekistan for 2019–2025 places special emphasis on deep processing of wool, transforming raw materials into export-oriented products, and enhancing competitiveness.

Currently, the 2BT-150Sh type opening and cleaning machines used in enterprises provide a certain level of efficiency, but they also have disadvantages such as mechanical damage to fibers during the cleaning process, an increase in the proportion of short fibers, and a decline in raw material quality. From this perspective, the proposed new opening and cleaning machine makes it possible to clean raw materials more effectively, remove unusable and short fibers, and preserve the length of wool fibers.

Materials and methods. Since fiber length was also considered important in the cleaning process, analyses were carried out. Accordingly, samples of wool fibers before and after the opening process were formed into bundles [1]. The fiber length was measured using a ruler. In determining this fiber length, three different samples were used [2].

Samples of raw wool, wool cleaned with the existing 2BT-150Sh cleaning machine, and wool cleaned with the proposed opening-cleaning machine were each taken in equal amounts of 0.01 g, placed on white paper on the laboratory table, and their lengths were determined [3].

Figure 1. Sample of Karakul sheep wool shorn in the spring season.

The purpose of determining the average length of this wool fiber is to establish the quality of the wool fiber by measuring the modal mass length, the amount of short fibers, and the average fiber length. The experimental results of determining the fiber length from three different wool samples were summarized in the following table [4].

Table 1

Table for determining the average length of wool fiber.

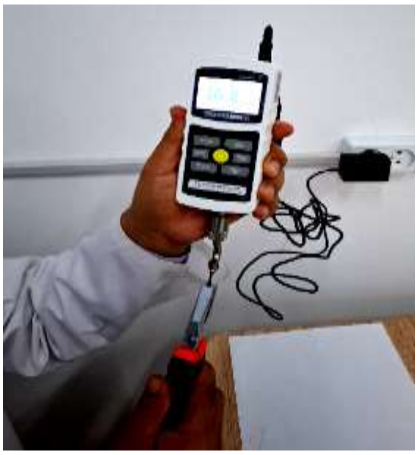
Study of the Average Length of Wool Fiber			
Wool grade	Fiber length without passing through the opening-cleaning machine, mm	Fiber length after processing with the existing 2BT-150Sh machine, mm	Fiber length after processing with the proposed machine, mm
Grade I	70-75	65-71	69-74
Grade II	80-90	79-84	79-88
Grade III	90-100	87-94	89-98

The analysis of the experimental results (Table 1) shows that, in the cleaning process, the effective separation of unusable, short fibers and coarse fibers from the raw material contributes to improving both its quality and its length [5].

Taking into account that fiber damage during the opening process depends on fiber strength, the breaking force was determined [6]. For this purpose, a Mark-10 M7-200 type mobile force gauge was used to measure the breaking force of fibrous raw materials (Figure 2).

The second experiment aimed to determine the degree of fiber damage under the influence of dynamic force. In this experiment, three types of samples were taken: raw wool, wool cleaned with the existing 2BT-150Sh cleaning machine, and wool cleaned with the proposed opening-cleaning machine. Equal amounts of 0.01 g from each sample were weighed on an electronic scale. These three types of samples were then manually twisted into a bundle shape [7].

The twisted wool sample is shaped into a small rope. A loop is formed, and its two ends are fixed with clamps [8]. The hook of the electronic dynamometer is passed through the middle of the loop, and the sample is pulled until the wool fiber breaks. The electronic dynamometer records and stores the maximum breaking force of the wool fiber sample in Newton units. Three



types of wool fiber samples, each weighing 0.01 g, were tested three times according to this procedure. The results of the electronic dynamometer measurements were recorded in Table 2 [9].

Figure 2. Mobile force gauge Mark-10 M7-200.

When the wool sample processed through the proposed machine was subjected to dynamic force, significant positive results were obtained from this experiment. The results of the experiments were recorded in the following table.

Table 2

Determination of the breaking force of wool fiber using the Mark-10 M7-200 electronic dynamometer

Wool grade	Breaking force of wool fibers depending on the scutching process (based on 0.01 g wool samples)

	Breaking force of raw wool sample before scutching, N	Breaking force of wool sample cleaned in existing 2BT-150Sh machine, N	Breaking force of wool sample cleaned in proposed machine, N
Grade I	24,7	13,3	19,0
Grade II	21,4	11,8	15,2
Grade III	15,1	7,5	10,6

The strength of wool fiber at break was determined using an electronic Mark-10 M7-200 mobile force gauge, based on wool fiber samples from different processing stages. The results showed that as the degree of fiber damage increases, the breaking force resistance decreases. The raw wool fibers used in the experiments did not experience damage before processing [10], therefore their breaking force remained relatively high, in the range of 15.1–24.7 N.

For wool samples cleaned in the existing 2BT-150Sh scutching-cleaning machine, the higher level of fiber damage and the presence of coarse and defective fibers caused the breaking force to decrease to 7.5–13.3 N across the three grades [11].

When the wool samples were processed in the proposed scutching-cleaning machine, experiments carried out on the same three grades showed that due to the lower degree of fiber damage and fewer coarse fibers, the breaking force remained higher, in the range of 10.6–19.0 N.

It should be noted that in these experiments only the breaking force was measured to determine fiber strength. The elongation at break was not studied.

Results and discussion. The third method for studying the degree of wool fiber damage was carried out using a **Bio Blue BB-4253 microscope**. The damage in wool fibers was examined by placing the raw material under the microscope, and the results were obtained

through computer software. Wool samples processed in the existing **2BT-150Sh machine** and in the **proposed machine** were prepared in three replications and placed on white paper. The samples were then positioned on a stand, and the microscope eyepiece was adjusted to **40× magnification**. Consequently, the microscope transmitted the results to the computer program, which displayed them on the monitor (Fig. 3).

Fig. 3. Degree of wool fiber damage observed using the Bio Blue BB-4253 microscope.

During the microscopic examination of the wool fibers, three types of samples showed three distinct conditions. In the raw wool fibers, the presence of **grease, sweat, and foreign impurities** was observed. In addition, a high amount of **defective fibers** such as coarse fibers and covering fibers (kemp wool) was identified in the sample.

The sample of wool cleaned in the existing 2BT-150Sh scutching machine showed a lower amount of foreign impurities. When the microscope eyepiece was brought closer to the raw material, the presence of grease, foreign particles, and adhesive minerals in the sample was observed in small amounts. However, damaged and even broken coarse, semi-coarse, kempy fibers, semi-fine wool, and dry fibers were detected.

Conclusions. The wool samples processed using the proposed scutching-cleaning machine were examined under the microscope. The content of foreign impurities in the wool fibers was found to be lower. The sample contained almost no coarse fibers, kempy fibers, or dry fibers. No significant damage was observed in the semi-coarse wool fibers. The experimental results indicate that the wool samples processed by the proposed scutching-cleaning machine showed fewer defects and the absence of coarse, kempy, and dry fibers. This demonstrates that the optimal parameters of the proposed scutching-cleaning machine have been correctly selected.

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