Study of the influence of the guiding device on increasing the efficiency of fiber cleaning

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Abstract. In this article, the techniques and technologies established in the process of cleaning cotton and fiber are based on the fact that in the republic the cotton harvest is carried out mainly by hand. In order to preserve the natural quality of the cotton harvested in cotton pickers, it is necessary to improve the equipment for cleaning the fibers. The fiber refining process is one of the most important final processes in the cotton processing process, given that the quality of the fiber largely depends on the efficiency of this process. The article analyzes the scientific work on the mechanization of the type of collection and increasing the efficiency of its cleaning. In order to increase the efficiency of machine cotton picking, information is given on the need to improve the equipment for cleaning fibers used in cotton ginning enterprises. The research is based on the need to replace a specially designed device that guides the fiber to the desired tooth of the first saw cylinder located in a dual drum fiber cleaning equipment. It turned out that the new structural device can be installed on the existing equipment for cleaning fibers of JSC "Zarbdor pakhta tozalash" in the Jizzakh region and can produce from 18.2 to 127.4 kg of fiber from cotton of the first and fourth grades. Based on the results of the study, recommendations were given for widespread introduction of cotton into the production of cotton by installing a special guiding device on the equipment for cleaning fibers installed at primary processing enterprises.

1. Introduction
In recent years, special attention in our republic has been paid to the production of high-quality finished products that ensure competitiveness in the world market on the basis of improving technologies and technologies of the ginning and textile industries, deep processing of raw cotton. At a meeting held by the President of the Republic of Uzbekistan Shavkat Mirziyoyev on April 23, 2020, dedicated to ensuring the stability of the textile industry, as well as mitigating the consequences of the current pandemic, the export potential of the industry has doubled over the past three years, reaching $1.6 billion last year, stressed that this is not enough. He instructed to increase the production of finished products by 4-5 times by 15 billion dollars in the next 5 years, for this he instructed to reduce the cost in comparison with competitors, expand the range of products that go to the foreign market and radically improve the quality of cotton grown in the Republic of Uzbekistan [1].
In addition to all this, an order was adopted by the Cabinet of Ministers of the Republic of Uzbekistan No. 398 of June 22, 2020 on measures to organize the activities of cooperative activities for the cultivation and processing of raw cotton in order to ensure the implementation of the Resolution of the
President of the Republic of Uzbekistan No. On measures for the widespread introduction of market principles in the cotton sector” [2]. The decree states that cooperatives for growing and processing raw cotton were created on the basis of a voluntary merger of farms. Their main tasks are the receipt, storage and processing (by the mill method) of raw cotton grown by producers, the organization of the introduction of advanced foreign experience and resource-saving innovative technologies in order to efficiently use the land belonging to agriculture and increase productivity, as well as other tasks. Deep processing of raw cotton grown in our country to provide quality products to the domestic and foreign markets is one of the most important tasks of scientists in this field and the cooperative.

95% of cotton grown in our republic is picked by hand. The Resolution of the Cabinet of Ministers No. 21 of January 14, 2020 was developed to gradually reduce the amount of picking by hand for picking cotton on machines [3]. The decree provides for a six-year program to significantly increase the production and supply of cotton picking machines, which provides for the introduction of phased mechanization of cotton picking by 2026. In order to increase the efficiency of the cleaning process, to improve the quality of the fiber obtained from difficult-to-clean selection varieties and cotton collected by machine harvest, it is necessary to widely introduce 2VPM fiber cleaners with improved working parts with two drums instead of cleaners with one drum. Ensuring high quality fiber production, improving quality, increasing efficiency and productivity through the improvement of cotton fiber cleaning machines operating on cotton cleaning technology is one of the urgent problems [4, 5, 6]. With this in mind, there is a need for structural analysis and effective design of fiber cleaning equipment.

With this in mind, research methods were used to determine the cleaning efficiency of a fiber cleaner in order to theoretically substantiate the effect of an improved fiber cleaner on production efficiency and cleaning efficiency, based on the analysis of the study and the results of each study.

2. Method

In this work, ginneries use existing fiber cleaning equipment in the production process and a guide device as a proven device to increase the adhesion of the fiber to the first saw cylinder to improve its cleaning efficiency. The main technical parameters of the existing and subsequent installation of the fiber guiding machine are shown in Table 1. This device is used in the process of cleaning fibers in ginning plants. The cleaning efficiency of the fiber cleaner is 30-32% for the first grade and 33-35% for the lower grades [7-13].

| Table 1. Comparative analysis of fiber cleaning equipment |
|---------------------------------------------------------|
| The name of indicators | Existing fiber cleaner |
|------------------------|------------------------|
| Fiber performance      | 2000                   |
| Cleaning efficiency,%  |                        |
| - in the first varieties | 30-32                  |
| - in the low grade     | 33-35                  |
| The amount of fibers in the waste composition, suitable for spinning | 25 |
| Electricity costs      | 5.5                    |
| Metal costs            | 2518                   |

2.1. Experimental apparatus

In order to influence the efficiency of cleaning cotton, machine picking, the quality of fiber and yarn and create an effective cleaning technique - to prevent the loss of viable fibers in technological processes and to reduce cleaning time, a specially developed instruction was developed, shown in Figure 1.
Figure 1. Design drawing of a specially designed guide device

Figure 2 shows the structure of the attachment on top of the brush, which is attached to the teeth of the saw when making a device with a special design.

Figure 2. Installation of a specially designed device on the equipment: guided device. 2- brush

In accordance with the technical documentation, RIM Ustakhonasi LLC, which is part of Pakhtasanoat Ilmiy Markazi JSC, has developed a new device design, which is installed on a two-drum fiber cleaning equipment installed at Zarbdor Pakhta Tozalash JSC in Jizzakh region. A general view of the installed guide and specially designed device on the cleaning equipment is shown in Figures 3 and 4.
2.2 Formation of the problem

For the analysis, the cleaning efficiency of the fiber cleaning equipment was studied. The cleaning efficiency of a fiber cleaner is determined as follows.

\[
K = \frac{S_1 - S_2}{S_1} \times \frac{1}{1 - \frac{S_2}{100 - B}} \cdot 100
\]  

(1)

Where: \(G_1\) is the mass of cleaned fiber; \(S_1\) and \(S_2\) are the total number of defects and debris in the fiber before and after cleaning the fiber.

3. Result and Discussion

In order to improve the performance of the fiber cleaning equipment, the cleaning efficiency and the amount of fibers in the waste that is suitable for spinning, the effect of the improved guide device installed on the fiber cleaner on the cleaning efficiency of the fiber was studied by improving the brush function of the fiber cleaner. The results are shown in Table 2.
Table 2. Effect of the guiding device on the quality and quantity of products of the existing and improved fiber cleaning device

| The name of indicators | Cotton fiber in grades |
|------------------------|------------------------|
|                        | 1st grade | 2nd grade | 3-grade | 4-grade | 5-grade |
|                        | Existing  | New       | Existing | New     | Existing | New     | Existing | New     | Existing | New     |
| Experience1            | 1         | 2         | 3        | 4       | 5        | 6       | 7        | 8       | 9        | 10      | 11      |
| Total number of defects in fiber composition. Before cleaning fiber pcs | 347 | 348 | 358 | 355 | 376 | 373 | 388 | 390 | 398 | 396 |
| Total number of defects in fiber composition. After cleaning the fiber pcs | 241 | 239 | 246 | 240 | 252 | 248 | 257 | 256 | 263 | 259 |
| Cleaning effect, %     | 30.5      | 31.3      | 31.3     | 32.4    | 33.0     | 33.5    | 33.8     | 34.4    | 33.9     | 34.6     |

From the results obtained from the table, it can be seen that the influence of the total number of defects in fiber on existing and improved fiber cleaners on cleaning efficiency is presented in the first and fifth grades. The cleaning effect of the fiber cleaner is from 30.5% to 31.3% for the first grade, from 31.3% to 32.4% for the second grade, from 33% to 33.5% for the third grade, from 33.8% up to 34.4% for the fourth grade, from 33.9% for the fifth grade. From the first experiment, it can be seen that the cleaning efficiency increased to 34.6%.

By improving the equipment, it is possible to prevent the transfer of 18.2 kg to 127.4 kg of fiber, suitable for the production of products from the first to fourth grade, into the waste composition. Thanks to the improvement of the equipment, energy consumption is saved by 10-15%.

By installing a new design device in the fiber cleaning equipment, it will be possible to separate 20-30% of the fiber from the waste suitable for production.

4. Conclusions
We can say about the need to improve the technology of cotton production, since now we are moving on to harvesting cotton by machine picking. This requires the replacement of the specially designed guide at the pickup point of the fiber cleaner, which guides the first saw onto the straight tooth of the cylinder. Through the implementation of the proposed design solutions, it was found that fiber cleaning equipment attached to the gin can hold fibers suitable for the production of first and fourth grade cotton from 18.2 to 127.4 kg. This prevents fiber wastage in the equipment and increases the volume of product used by improving fiber quality. Based on the analysis carried out, it is recommended to widely introduce the guiding device into production.

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