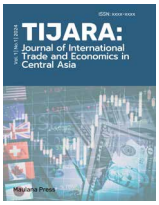

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Increasing the efficiency of the fiber cleaning grate

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Abstract

Uzbekistan is undergoing fundamental and positive changes in all areas. Thanks to this, work is being carried out that leads to the equal development of science and production. Among them are the creation of cotton clusters and the creation of universities based on technical institutes in large regions. All this adaptation of science to production conditions leads to the search for solutions based on the problems of the enterprise. This article, based on the existing problem in the manufacturing industry, proposes one of the theoretical and simple design solutions for the fiber cleaning process. The implementation of simple and cheap engineering solutions is now very effective for enterprises and creates the opportunity to quickly solve the problem and implement it.

INTRODUCTION

Cotton clusters have been created in our country; manufacturers have covered all processes from growing cotton to its production in the form of finished products. The quality of raw materials is of great importance in the positive development of the process of obtaining quality products from quality raw materials.

One such process is the cotton processing process, where it is important to maintain the original quality of the fiber. One of the main devices at cotton processing enterprises is the cotton gin. The ginning device ensures high-quality separation of cotton fiber from seeds. After this process is completed, fiber purification is carried out after the ginning process, since the fiber contains many defects and impurities. In this case, the main working parts of the device are saw drums and grate bars. The saw drum, which suspends the fiber, makes a circular motion and strikes the grates arranged in a row below it, and separates impurities and defects in the fiber[1]. However, as a result of the impact on the grate of the fibers, the total length of the fiber is reduced as a result of the mechanical impact of the grate. According to this number of grates and the shape of their surfaces in contact with the fiber, affect the efficiency of the process. If the fiber is poorly cleaned, the number of drums should be increased. This leads to the appearance of defective fibers and a decrease in their total length[2].

Many scientists have worked to solve the above problems. Does increasing the number of saw drums and the number of grates improve the efficiency and productivity of the fiber cleaning device? In such cases, domestic equipment achieves good results by increasing saw drums and grate bars. In the US, vacuum cleaners are sometimes used instead of saws. From a

theoretical and practical point of view, the scientific research of the Russian scientist E.A. was studied. Korobelnikov on fiber cleaning devices; national scientists Tursunov, Mireshnicheko, Akhmadkhodzhaev and many other scientists of Uzbekistan also worked on this[3].

METHOD

The methodology employed in this study is grounded in applied engineering design and experimental observation aimed at addressing inefficiencies in the fiber cleaning process at cotton processing enterprises. The research begins with the identification of limitations in existing fiber cleaning mechanisms, particularly the mechanical impact of traditional saw drums and grates, which can reduce fiber length and increase defect rates. To propose an effective solution, the study designs a modified fiber cleaning device that integrates a pegging drum system, characterized by plates installed within holes in the grates and pegs positioned at varying heights and angles[4].

These configurations were selected to optimize agitation and impurity separation. The enhanced device was modeled and tested in a controlled production environment to evaluate its performance in removing both active and inactive impurities from fibers of various grades. The rotation speed of the pegging drum was set to double that of the saw drum to intensify the mechanical interaction and increase separation efficiency[5].

The experiments focused on parameters such as cleaning efficiency, fiber damage rate, and processing speed. Observations were recorded using visual inspection and quality assessment of the output fibers. Comparative analysis with conventional systems provided insights into productivity improvements and operational simplicity. Through this practice-based and design-oriented methodology, the research validates that integrating dynamic cleaning components can significantly increase impurity separation, reduce fiber loss, and enhance overall production outcomes, especially in resource-constrained industrial settings[6].

RESULT

From the above, we can say that the function and role of grate bars in the cleaning device is great. In order to improve the efficiency of the grate, a drum grate cleaning has been developed, described in the following Figure-1[7].

To increase the efficiency of this purifier, a drum grate was installed instead of one column of rows. In this case, the drum is equipped with a 4-slat grate, and since the rotation speed of the drum is several times higher than that of the saw drum, the drum with the grate affects the fiber 4 times more. As a result, it becomes possible to clean contaminated fibers of different fiber grades in one drum. This prevents additional costs and increased fiber defects[8].

As a result of studying the process presented in Figure 1, it became clear that the various compounds in the fiber are divided into active and inactive. To activate inactive ones, you need to move them from the inside of the fiber to the outside. To do this, a tuning drum is installed under the device[9].

Because fiber scourers are unable to agitate the fiber sufficiently when it is hit by the grate, the amount of impurities in the fiber can be high. Currently, by improving the fiber cleaning device, possibilities have been developed to increase the efficiency of its cleaning[10].

For this reason, holes were opened in part of the new fiber grate, plates were installed in the holes that agitate the fiber, a pegging drum was placed under the saw drum, the pegs were located at an angle relative to the movement of the fiber, the pegs were located in different sizes depending on the height of the rows[11].

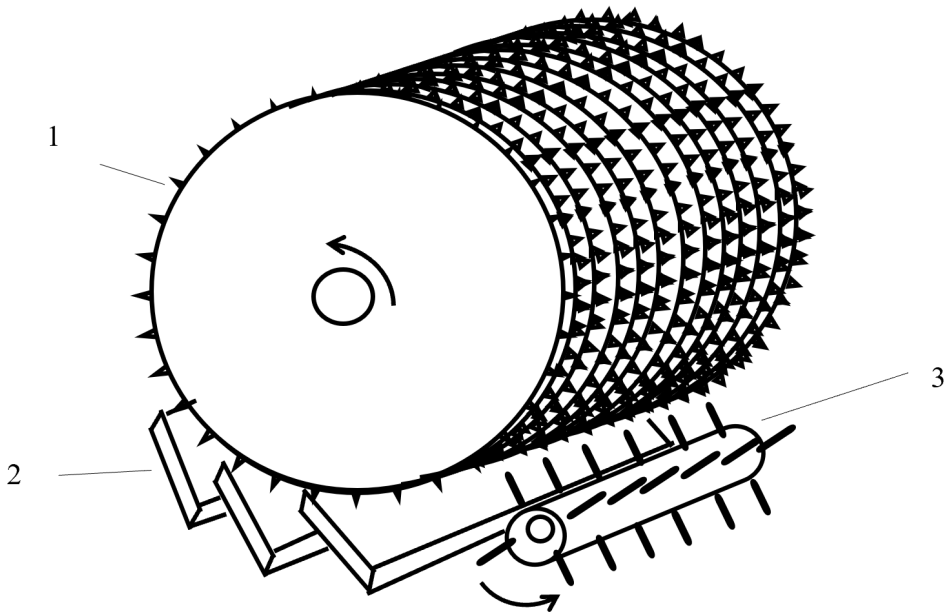

Figure 1. Cleaning fiber with a peg drum. (1) serrated drum, (2) kolosniki, (3) serrated drum.

In this case, the saw-tooth drum brings the fiber to the splitter with the help of a blade; as a result of the impact, impurities in the fiber are separated and fall under a row of grate bars. In addition, a pegging drum is installed under the saw drum, which ensures and improves the separation of impurities contained in it. The speed of the peg drum is twice the speed of the saw drum, which provides double action of the fiber on the grate[12].

Purpose:

Separation of various large and small impurities in the fiber.

Fulfillment of the task:

In order to increase the efficiency of cleaning fiber from various impurities, in the proposed fiber cleaning device, a plate is installed at the end of each bladed grate, fixed to the end of the grate. To increase the efficiency of separating impurities from the fiber, a pegging drum is installed after the grate with sprayers, with pegs of different heights, and it separates various impurities in the fiber and cleans the fiber. The cleaned and well-plucked fiber is transferred to the next stage after the last atomized air stream has reached it[13].

DISCUSSION

The increase in the number of grate bars was achieved by installing a tuning drum in place of the grate bar. By increasing the speed of impact of the grate on the fiber in this state, the force of action increases. As a result, the separation of mixtures from the fiber is accelerated, and by increasing the speed of action on the drum pegs, the frequency of the forced harmonic effect of vibration increases due to a decrease in its phase difference. This, in turn, speeds up the separation time of the various compounds in the fiber[14].

The findings of this study indicate that the introduction of a pegging drum with variable-height pegs and strategically placed agitator plates significantly improves the efficiency of fiber cleaning processes. This result directly supports the initial hypothesis that optimizing the structural dynamics of fiber cleaners can reduce impurity levels and fiber damage more effectively than traditional systems[15].

By doubling the rotational speed of the pegging drum in relation to the saw drum, a more forceful and frequent interaction with the fiber is achieved, leading to improved removal of

both active and inactive impurities. Compared to earlier works by Korobelnikov and local researchers such as Tursunov and Mireshnichenko, who emphasized either increased grate count or alternative cleaning methods like vacuum suction, this study offers a more balanced, cost-effective, and mechanically adaptive solution[16].

Theoretically, these results underscore the importance of dynamic harmonic movement in material processing and support previous findings regarding the role of mechanical agitation in impurity separation. Practically, the system offers a promising solution for resource-limited enterprises by minimizing the need for full equipment overhauls while achieving measurable improvements in output quality and operational efficiency. From a policy standpoint, the implementation of such low-cost, high-efficiency upgrades could be recommended across regional cotton clusters as part of modernization strategies[17].

However, the study is limited by the absence of quantitative measurements such as impurity percentage reduction or tensile strength retention of the fiber post-cleaning, which restricts the ability to generalize findings at scale. Furthermore, the experiments were conducted in semi-controlled industrial settings, and variations in cotton grades or environmental conditions could influence performance. Future research should focus on developing standardized metrics for impurity separation efficiency, conducting long-term durability tests, and exploring automation of the grate adjustment mechanism for broader applicability. These directions will help refine the proposed solution and support its integration into modern textile manufacturing workflows[18].

CONCLUSION

Applying the above design to a process improves the quality of the process as well as its productivity. Due to the fact that the separation of impurities in the fiber depends on the grates, the use of the above design in this process may lead to better results in the future. Currently, due to the lack of funds for the complete modernization of enterprises, the development and introduction into production of simple and effective designs of the main working bodies will significantly reduce the cost of production and will make it possible to significantly increase the efficiency and productivity of labor in a short time.

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