Study on possibilities of scarring ways to reduce in the cotton cleaning process

E T Mukhametshina¹, A Jamolov², and R M Muradov³

¹Department of Natural Fibers and Fabric Processing, Jizzakh Polytechnic Institute, Jizzakh, Uzbekistan
²Department of Technology of Cultivation and Processing of Agricultural Products, Namangan Institute of Engineering and Technology, Namangan, Uzbekistan
³Department of Technology of Primary Processing of Natural Fibers, Namangan Institute of Engineering and Technology, Namangan, Uzbekistan

*Email: mukhamadiyeva94@mail.ru

Abstract. This article provides a diagram of the technological process of cotton primary processing plants. It also shows which of the machines installed in the technological process can damage the seed, as well as the operation of the machine and the main working bodies, which separate the fine contaminants in the cotton. It is theoretically based on the fact that cotton ginning machines can reduce the impact force by improving the design of the working bodies. A device that has been proposed allows cotton to be cleaned from fine contaminants using a vibrating mesh surface without affecting its natural properties. In order to improve the technology of cleaning cotton from fine contaminants, an effective scheme of pile drum and mesh surface construction has been developed. With the help of a sloping mesh surface device, the existing impurities in the cotton were reduced by 0.2%. The graph of the formation of various defects in the fiber content as a result of seed damage during cotton cleaning is given.

1. Introduction

Production of high-quality fiber in accordance with world standards poses an important task for specialists and scientists in the field of cotton processing, such as improving the existing equipment and technology [1]. In turn, the increasing level of improvement of spinning and weaving equipment requires great attention to the quality of cotton fiber.

One of the main tasks of modern production is to improve the living conditions of the population through the priority growth of the national economy, the development of scientific and technical system [2-4]. In addition, it is necessary to pay attention to the issues of production capacity of the republic, efficient use of resources and improving the quality of work.

Due to the high volume of cotton with high pollution around the world, especially machine-picked cotton, to improve the techniques and technology of primary processing of cotton, to develop a theoretical basis for the process of fine-grained cotton, to justify the parameters and operating modes of working parts and mechanisms; and extensive theoretical and complex empirical research is underway to determine the optimal values of the geometric and kinematic dimensions that provide clearance. At the same time, it is important to ensure the efficiency of ginning cotton and maintain the original quality of the product, reduce the strong impact on cotton ginning and cleaning of impurities,
the development of soft-mode ginning technologies, and the creation of resource-efficient working bodies of ginners.

2. Method

2.1. Problem formulation

It is known that contaminants are passive and active in terms of processing cotton. Passive contaminants are easily separated from cotton when lightly shaken. Active contaminants are difficult to separate from cotton. In order to separate the active impurities from the cotton, it is necessary to make them passive beforehand. Theoretical research shows that when the surface of the net vibrates, the trajectory of the cotton fiber changes. This change allows the cotton piece to move on a longer uneven trajectory on the mesh surface. Today, a remote experimental device is being developed to test these ideas in practice. This device not only allows the mesh surface to vibrate, but also increases its useful surface area [5, 6].

Due to the proposed changes, the deterioration of the quality of cotton during its transfer to processing machines will be prevented. As a result, the raw material is not damaged; there are no defects in the fiber content. Due to the improvement of quality, the company will be able to get great economic benefits.

![Diagram of cotton processing plants](image)

**Figure 1.** In the primary processing plants of cotton technological process scheme

Today, raw cotton is mainly harvested by hand, so its quality is much higher than machine harvesting. Accordingly, there is no need to repeatedly pass the cotton through the ginning machines in the technological process. With this in mind, many businesses are using short technologies. This method saves electricity as a result of shortening the number of machines on the one hand, and on the other hand protects it from additional mechanical impacts.

In order to reduce the energy consumption of the vibrating mesh surface cotton cleaning device created as a result of theoretical research, it was found expedient to install the cotton after the air-carrying device, remove the movement from the vacuum valve of the separator and prepare for experiments [7, 8].
The efficiency of the process of cleaning cotton from fine impurities certainly depends on the slope angle of the mesh surface. Therefore, it was found that the grid surface of the experimental sample of the device gave the highest efficiency when the slope angle \( \alpha = 30^\circ \).

It is recommended to use S-6524, 1st grade cotton raw material during testing.

The technological process of primary processing plants of cotton is carried out in the following scheme (see Figure 1) [9, 10].

Examining the scheme of the technological process of ginners in Figure 1, it was found that the damage to the seeds occurs mainly in the following machines (Figure 2).

**Figure 2.** Machines that damage seeds in the technological process of cotton processing

2.2. *Experimental apparatus*

In this article, the authors explore the factors influencing seed damage in the process of cleaning cotton from fine contaminants. The scheme of machines for cleaning cotton from fine impurities is shown in Figure 3.

**Figure 3.** Schematic of a machine that cleans cotton from fine impurities: 1 supply roller, 2 mesh surface, 3 pile drum, 4 impeller belt conveyor, 5 nov
The ginning machine supplies the cotton through the mine to supply 1. The supply rollers rotate in opposite directions to transfer the cotton evenly to the pile drum 2. The pile drum 2 drags the cotton over the mesh surface 3 and its fine impurities fall from the mesh to the belt conveyor 4 passes the cleaned cotton through the trough 5 to the next machine [11].

Today, ginners use 1 HK cleaner to clean cotton from fine contaminants. In this cleaner, 8 of the pile drums in Figure 3 are mounted in series in the horizontal plane. Under the pile drums is placed a rolling net.

As a result of the rotation of the pile drums at a speed of 480 rpm, the cotton is crushed and when it is dragged on the surface of the net, small contaminants are released. The cleaning efficiency of 1XK machine is around 40-45%. Although the distance between the pile drum and the mesh surface is 14-20 mm, when this cleaning machine is running, the seed damage in each drum can be 0.2-0.6% depending on the navigation of the cotton.

In grades I-II of cotton, when the cotton contamination is up to 5.0%, it is sufficient to pass it through 8 pile drums to clean it.

If the contamination of grade III cotton is up to 8.0% during processing, it is recommended to pass it through 16 pile drums and two saw drums for cleaning.

The cleaning efficiency of the machine is determined using the following formula.

\[ K = 100 \left( 1 - \frac{C_1}{C_2} \right) \]  

where: \( C_1 \) - pollution of raw cotton, \( C_2 \) - pollution of cleaned cotton

The cleaning zone of the cotton raw material decontamination technology mainly involves pile drums and meshes surfaces. In order to improve the technology of cleaning cotton from fine contaminants, an effective scheme of pile drum and mesh surface construction has been developed.

Figure 4 shows a schematic of a machine pile drum that cleans fibrous materials from contaminants.

The structure consists of a drum 1, a cylindrical 2 mounted on its surface in a checkerboard pattern, and polygonal pegs 3. When the drum rotates 1 during operation, piles 2 and 3 rotate alternately, affecting the fibrous material. At the same time, the impulse force acting on the cotton changes cyclically which leads to the intensive separation of fine impurities from the cotton.

The versatile mesh surface of the fibrous material cleaner allows to significantly increase the cleaning efficiency of cotton from fine contaminants. Grinding in the cotton swab cleaning zone provides a trajectory of motion along the broken line that forms the mesh surface. In this case, the direction of interaction of the cotton fiber with the polygonal mesh surface plane changes cyclically. This results in the effective separation of fine impurities from the cotton [12].

During the operation of the cleaning machine, the drum 8 piles 9 drag the cotton raw material along the mesh surface 2 (Figure 5). In this case, the cotton pieces move along the edges of the mesh surface 1, changing the trajectory of the movement and cyclically interacting with the multi-sided mesh.
surface 1. This leads to the efficient separation of contaminants in cotton. Separated contaminants exit through holes 2. In this case, the elastic bushing 6 is deformed due to the change in the mass of cotton 1 on the mesh surface. The change in the mass of the raw cotton over time leads to a change in the deformation of the bushing 6. As a result, the mesh surface 1 oscillates at a certain frequency and amplitude [13].

![Figure 5. Mesh surface diagram of fibrous material cleaner](image)

At the beginning of the zone of drag of raw cotton in this zone due to the size of the diameter of the elastic bushings 6 (d1> d2) the mesh surface oscillates at a large amplitude 1, and at the end of the zone the vibration amplitude of the mesh surface 1 is low. The frequency and amplitude of vibration of the mesh surface 1 depends on the stiffness of the flexible bushings 6, the mass of the mesh surface 1 and the change in the mass of the sliding cotton. Vibration of the mesh surface 1 leads to intensive separation of contaminants, which increases the cleaning efficiency.

3. Results and Discussion

Figure 6 shows the formation of various defects in the fiber content as a result of seed damage during the cleaning of contaminants in the cotton gin on cotton ginning machines.

![Figure 6. Scheme of dependence on the process of cleaning fine contaminants and defects in cotton](image)
In addition, according to the Figure 6, the number of transitions in the cleaning machines along the U axis and the contamination of the cotton along the X axis. In this graph, line 1 shows a decrease in contaminants from the cotton content. Line 2 shows that defects in the fiber content are caused by damage to the seeds as a result of passing through the cotton gins. At the point of intersection of these lines, it is ensured that the fiber quality and the amount of impurity are optimal. This is done using 3 deflection lines to lower point A. This is done by cleaning the 3 deflection lines without affecting the natural properties of the fiber. As a result, there are no additional defects in the composition of the fiber along the 2 deflection lines, ie it does not change.

In the process of cleaning the raw cotton, it is repeatedly passed through cleaning machines consisting of pile drums in order to completely separate the impurities in it. This increases the mechanical impact on the cotton, leading to additional defects in the fiber content. It is necessary to increase the efficiency of cleaning machines and change the processing process so that the cotton is less mechanically affected.

If we reduce the amount of fine impurities in the cotton during the transportation of cotton by pneumatic transport, then the graph of the process of its cleaning will be as shown by the dashed line in Figure 6. The graph remained unchanged as there was no change in the amount of defects formed in the fiber as a result of the passage through the pile drums. The results of observing the process of transporting cotton with the help of air showed that raw materials are unevenly transferred through pneumatic conveying pipes. As a result, cotton moves inside the pipe, accumulating in some places, and in some places rarely splitting into specific pieces [14].

The graph A, which represents the amount of impurities in the cotton, moves to point A1, which is formed at the intersection with the graph, which represents the formation of defects in the fiber content.

The difference between these points is that it reduces the defects that are formed in the fiber content during the cotton processing process. Analyzing the theoretical results obtained, it is possible to reduce the existing impurities in the cotton content by 0.2% using a sloping mesh surface device. A similar result was seen when the fibers coming out of the demon were examined. For example, the impurity of the fiber coming out of the gin during the installation of the inclined mesh surface device was 2.2%, while the impurity of the cotton fiber passing through the mesh surface was 2.0% after the gin. Simply put, the amount of dirt removed from the cotton in one hour was 6 kg.

At present, the company plans to obtain 15% simple, 50% good and 10% high-grade fiber for Namangan-77, depending on the selection of cotton varieties. If, based on the above result, a device with a sloping mesh surface is introduced into the technological process of the enterprise, there is a possibility that the ordinary fiber will go better and even the fiber with good performance will go higher. As a result, the economic efficiency of the enterprise will increase significantly.

4. Conclusions
In this article examines the factors influencing seed damage in the process of cleaning cotton from fine contaminants. There is also a diagram of the machines for cleaning small contaminants. This article provides a diagram of the technological process of the primary processing plants of cotton. It also shows which of the machines installed in the technological process can damage the seed, as well as the operation of the machine and the main working bodies, which separate the fine contaminants in the cotton. It has been theoretically proved that cotton ginning machines can reduce the impact force by improving the design of the working bodies. In the cleaning of cotton from fine impurities, a cleaning device using a vibrating mesh surface without affecting its natural properties has been proposed. The study recommended the following: in grades I-II of cotton, when the cotton contamination is up to 5.0%, it is sufficient to pass it through 8 pile drums to clean it, if the contamination of grade III cotton...
is up to 8.0% during processing, it is recommended to pass it through 16 pile drums and two saw drums for cleaning.

In order to improve the technology of cleaning cotton from fine contaminants, an effective scheme of pile drum and mesh surface construction has been developed. However, the results of the research showed that in the process of applying the short technology, the cotton was not cleaned enough. As a result, the quality of the fiber produced is declining. Therefore, the company conducted research on the purification of raw materials from excess fine impurities, while maintaining the natural properties of cotton, which does not require additional electricity.

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