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RESEARCH ON REDUCING FIBER LOSS IN THE COTTON SEPARATION PROCESS

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Abstract: This article describes research aimed at drastically reducing the amount of free fibers escaping with air from a separator machine installed in the technological process of cotton ginning enterprises. In order to minimize the adhesion of cotton to the separator mesh surface, it is proposed to install trapezoidal guides on the separator device. To determine the effectiveness of the proposed guides, tests were conducted on 20 cm and 40 cm long variants and the corresponding results were obtained. The experimental results showed that when trapezoidal guides were installed, the impact of cotton pieces on the mesh surface was reduced by 35-40%. This ensures that the main part of the cotton raw material falls correctly into the vacuum valve, increasing the efficiency of the separator from air.

Keywords: cotton, seed, fiber, air, separator, free fiber, separator, vacuum valve, mesh surface, guide.

Introduction.

Today, as in all industries around the world, special attention is paid to the introduction of high-performance innovations in textile clusters. Also, improving the quality of manufactured products by improving existing techniques and technologies and creating resource-efficient solutions is an important task [1-3].

In the cotton ginning enterprises of the textile clusters of our country, significant progress is being made in obtaining high-quality cotton products while preserving the initial properties of the raw material. Positive changes are also observed in improving cotton processing techniques and technologies. In textile clusters, for the production of high-quality yarn, fabric and finished products, it is of great importance to preserve the natural properties of cotton from the initial stage of processing. It is this issue that determines the relevance of the topic. For this purpose, it is necessary to study and improve the design of the existing separator to increase the efficiency of separating cotton from air [4-7].

During the operation of the equipment installed in the technological process of cotton ginning enterprises, there are cases when the product, that is, fibers suitable for production, are mixed with the waste. The results of scientific research conducted by industry experts show that one of the reasons for the loss of fiber is the transportation of cotton through pneumatic transport pipelines using air, as well as during the processes of cotton cleaning, ginning and fiber cleaning. In the process of separating cotton from air in the separator, which is the main element of the air transportation device for cotton, it is often observed that the fibers are mixed with dust and air [8].

When cotton enters the working chamber of the separator along with air, a certain part of the cotton sticks to the mesh surface located on the side of the working chamber. The fibers are pulled together and released by the air sucked into the holes in the mesh surface. The main reason for this is that the cotton stuck to the mesh surface is removed by the comb. The release of loose fibers with dust and air and the process of removing the cotton stuck to the mesh surface with the comb increases the possibility of fiber loss.

Methodology

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During the technological process of cotton ginning plants, it is observed that some of the fibers suitable for the product are mixed into the waste. Scientific research has revealed that one of the reasons for fiber loss is the transportation of cotton using air in pneumatic transport pipes.

In order to preserve the natural properties of cotton, the movement of cotton in the working chamber of the newly designed separator was theoretically studied. The novelty of this design is that trapezoidal guides are installed on the side wall of the inlet pipe and are inserted into the separation chamber. In addition, trapezoidal guides are also located in the vacuum-valve direction. These guides reduce the movement of cotton under the influence of air towards the mesh surface [9].

During the operation, part of the cotton entering the separator's working chamber is retained by these deflectors. The cotton is then directed towards the vacuum valve. The aim of the study is to investigate the effect of changing the length and shape of the trapezoidal guides on the separator efficiency. Taking the above into account, a guide separator was selected for practical research.

This separator has a distribution chamber with mesh surfaces on the side wall. It also includes inlet and outlet pipes, scrapers for cleaning cotton stuck to the mesh surfaces, and a vacuum valve. The side walls of the inlet pipe are inserted into the distribution chamber and are made in the form of trapezoidal guides bent in the direction of the vacuum valve. The distance between the trapezoidal guides is 50 mm.

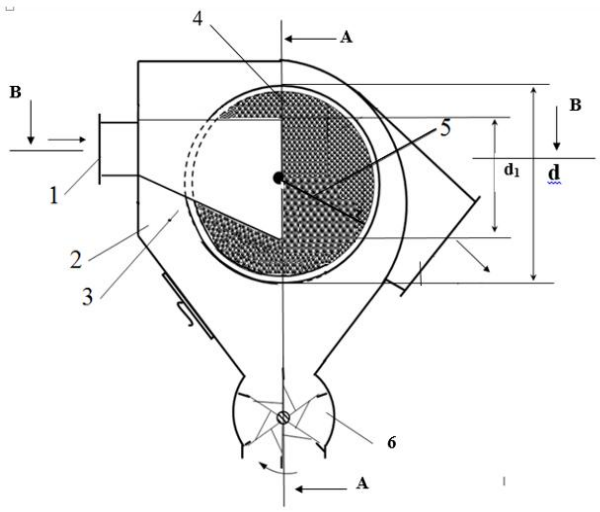

Figure 1. Schematic diagram of a separator with a guide (patent No. FAP 01879)

1-inlet pipe; 2-working chamber; 3-trapezoidal guide ;

4- mesh surface ; 5- strainer ; 6- air suction pipe ; 7- vacuum valve .

The scheme of the improved separator [10-11] (Figure 1) consists of the following: inlet pipe - 1, separation chamber - 2, vacuum valve - 3, scraper - 4, trapezoidal guide in the form of a guide - 5, mesh surface - 6 and outlet pipe - 7. When the separator device is started, the cotton raw material coming from the inlet pipe - 1 is directed to the separation chamber - 2 through guides - 5. Here, the air velocity in the chamber decreases. The main part of the cotton raw material hits the rear wall of the separator chamber and falls down under its own weight , into the vacuum valve - 3. The air and small impurities contained in it exit through the mesh surfaces - 6 and the outlet pipe

- 7. A small part of the cotton raw material sticks to the mesh surface - 6 due to the air flow. It is grated using a grater - 4.

The guides for cotton raw materials are made in the shape of a trapezoid. When the guides are installed, their direction is inclined towards the vacuum valve . This ensures that the main part of the cotton raw materials is directed towards the vacuum valve. As a result, the efficiency of the cotton-air separation process increases. After installing the trapezoidal guide, the reduction in the amount of cotton adhering to the mesh surface 3 allows the scraper - 4 to operate efficiently.

Figure 2. Separator working chamber with trapezoidal guide

1- trapezoidal guide; 2- mesh surface; 3-compression, 4-compression shaft.

An experimental copy of this device was made for practical research (Figure 2) and experiments were conducted on it. The determination of the amount of cotton fiber released along with air on the mesh surface is carried out in a cyclone connected to the blowing pipe after the separator. In this case, the bag installed at the bottom of the cyclone is checked every hour. To determine the amount of cotton stuck to the mesh surface, the mesh surfaces located on the sides of the working chamber are conditionally divided into four equal parts . To stop the scraper, it is necessary to remove the belt from the pulley mounted on its shaft. Then it becomes possible to determine the amount of cotton stuck to the mesh surface .

Results

Studies have shown that cotton pieces tend to stick to the mesh surface further away from the inlet pipe. After installing a trapezoidal guide in the working chamber, we observed a decrease in the amount of cotton stuck to this mesh surface. For this reason, in the studies, deflectors were installed on the inlet pipe of the new experimental copy. Below are the results of the experiments conducted during the study.

Table 1

Checking the efficiency of air separation in the separator

No.	Trapezoidal guide width, cm	Amount of various impurities released with	The fraction of cotton raw material that falls into the

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		dusty air, kg/hour	correct vacuum valve, %
1	20	3.7	92
2	40	3.5	94

As can be seen from the table analysis, when a trapezoidal guide is installed, the impact of cotton pieces on the mesh surface is reduced by 35-40%. This ensures that the main part of the cotton pieces entering the separator working chamber falls directly into the vacuum valve. This, in turn, improves air suction from the mesh surface and allows you to extend the distance of transporting cotton raw materials from the bale to 10-15 meters.

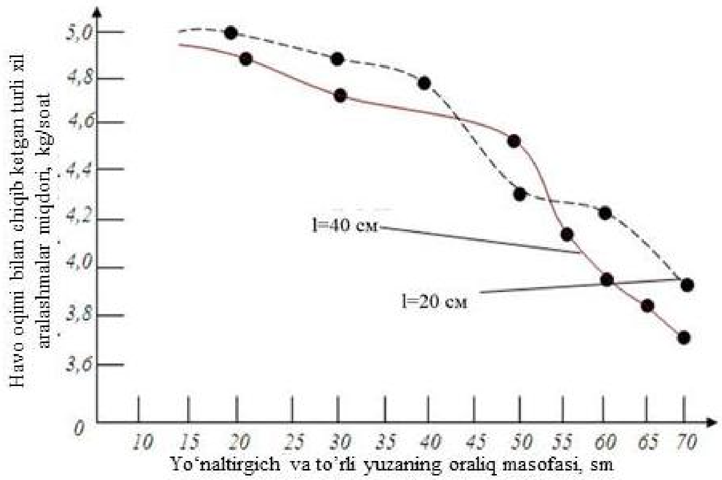

Figure 3. Dependence of the distance between the trapezoidal guide and the mesh surface on the amount of fiber ejected with the dusty air

The graphs show the results of testing two different configurations of the set of guides (trapezoidal guide width and length: 20 cm, 40 cm). The results show that the set with the largest number of guides in the trapezoidal shape performed the most effectively.

Conclusion

The research was aimed at reducing the amount of free fibers leaving the separator machines used in the technological process of cotton ginning plants and provided important practical results.

Trapezoidal guides were proposed as an effective solution to reduce the degree of cotton adhesion to the mesh surface of the separator and were installed in the device. As a result of tests conducted on the 20 cm and 40 cm long versions of the guides, the optimal parameters were determined, at which the separation process could achieve the highest efficiency .

In particular, it was determined that the separation process was most efficient when the length of the guides was 700 mm and the distance between them was 60 mm. It was also observed that the most efficient operation was observed for the set with the largest number of trapezoidal guides .

These changes increase the efficiency of cotton air separation, ensure that the cotton raw material falls correctly into the vacuum valve, and improve air absorption from the mesh surface. As a result, it is possible to extend the distance of cotton raw material transportation from the bale to 10-15 meters.

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