

BASED ON TECHNOLOGICAL PARAMETERS OF IMPROVED COTTON SEPARATORS

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Аннотация: Ушбу мақолада пахтани ташувчи ҳаводан ажратиш жараёнида тола билан таъсирда бўлувчи ишчи қисмларнинг маҳсулот дастлабки сифат кўрсаткичларига таъсири ўрганилди. Унга кўра мавжуд қонуниятлар асосида назарий таҳлиллар олиб борилди. Реал шароитда мавжуд технология пневмотранспортига узатишдаги муаммолар ва уларнинг амалий ечимлари устида назарий изланишлар олиб борилган. Пахтани ҳаводан ажратиш жараёнга таъсири бўйича назарий изланишлар натижаларига асосланган хулоса ва таклифлар берилган.

Калит сўзлар: пахта хомашёси, сепаратор, ишчи юзалар, пневмотранспорт ускунаси, зарба кучи, ишқаланиш кучи, частота, узилишдаги узайиш, микронейр, сифат кўрсаткичи.

Аннотация: В данной статье изучено влияние разделительных заготовок, подвергающихся воздействию волокна в процессе отделения хлопка от несущего воздуха, на исходные показатели качества продукции. По нему проводился теоретический анализ на основе существующих закономерностей. В реальных условиях проведены теоретические исследования проблем передачи существующей технологии пневмотранспорту и их практические решения. Даны выводы и предложения, основанные на результатах теоретических исследований влияния отделения хлопка от воздуха на процесс.

Ключевые слова: хлопковое сырье, сепаратор, рабочие поверхности, пневмотранспортное оборудование, сила удара, сила трения, частота, удлинение при разрыве, микронейрон, индикатор качества.

Abstract: In this article, the influence of separation blanks exposed to fiber in the process of separating cotton from the carrier air on the initial indicators of product quality is studied. A theoretical analysis based on existing patterns was carried out on it. In real conditions, theoretical studies of the problems of transferring existing technology to pneumatic transport and their practical solutions have been

carried out. Conclusions and suggestions based on the results of theoretical studies of the effect of separation of cotton from air on the process are given.

Keywords: cotton raw materials, separator, working surfaces, pneumatic conveying equipment, impact force, friction force, frequency, elongation at break, microneuron, quality indicator.

INTRODUCTION

Every year, 23-24 mln. tons of cotton fiber is produced, and its annual consumption is 0.5-1.0 million tons more, and the insufficient amount of fiber is covered by raw material reserves. Therefore, cotton cultivation has become one of the promising branches of agriculture on a global scale, and the issues of ensuring the efficiency of cotton production by improving not only the main production, but also the auxiliary technological processes in the initial processing of raw materials, in particular, the separation of cotton from the carrier air, have risen to the level of issues that determine the current state and prospects of the industry.

The primary cotton processing process consists of a unique technological chain, which consists of the following sequential processes: preparation, storage, transportation, drying, cleaning, separation of fiber and lint, and packaging of the finished product. The performance and quality of each equipment and process in this chain are closely related to the performance and quality of the machines preceding it. The entire technological process is provided with raw cotton by air transport equipment.

In cotton ginning enterprises, pneumatic conveying of cotton between gins and workshops is mainly used by suction type. The advantage of suction pneumatic conveying equipment is that the working air pipeline system can be easily and easily changed depending on the location of the storage areas of cotton ginning enterprises, and its length can be extended or shortened by connecting additional pipes to the primary air pipelines, as needed. The performance of pneumatic conveying equipment depends on the total production capacity of the cotton ginning enterprise, that is, the amount of raw cotton processed per hour, and in most enterprises it is an average of 10 tons of raw cotton per hour.

METHODS

Initially, some changes were made to the "SS-15A" and "SS-15M" brand separators developed in 1956, but the basic structures of the construction were preserved [1].

In many literatures on the transportation of cotton by air, in particular, V.A. Schwab, F.G. Zuev, A.M. Korn, A.M. Dzyadzio, A.S. In chamber studies, it was shown that the resistance of the air mixture movement depends on the air flow rate.

In particular, in [2] the author proposed installing a wiper tilted at 45 degrees relative to the radial axis to reduce cotton sticking to the mesh surface and ensure faster separation from it. In this case, issues such as cotton compression between the mesh surface and the wiper and damage to the seed were not taken into account.

Amirov R. In his work [3], he showed that the flow velocity upon arrival at the separator depends not only on the magnitudes of the components and the initial velocity, but also on the coefficient "k" and the concentration of the substance being separated.

A number of scientists [4,5,6,7,8] who were engaged in improving the separator's operation tried to carry out the process of separating cotton from air by using the inertial force generated by the movement of the cotton, by sharply changing the direction of the air flow.

The main part of the separator is the separation zone, where the product is divided. of the material It has been shown that a large chamber is required to ensure its separation from the air during the process of its mass, as described in [9].

In his work on the separation of bulk materials [10], N.E. Avdiev theoretically and experimentally investigated the process of separation of fine particles through a mesh surface. Particles that are in constant contact with the mesh surface are more likely to be separated from the air.

In his work [11], J. Urban studied the process of moving particles of different sizes with air. The basic laws of mechanics were used to determine the changes in particle motion and pressure loss, and the relationship between the air flow velocity and the material transport rate during the transportation of

materials by air flow was studied.

As a result of theoretical and experimental studies of the process of transporting raw cotton by air by P.V. Baydyuk [12], a number of regularities were identified.

Academician of the Academy of Sciences of the Republic of Uzbekistan H.A. Rakhmatullin [13], taking into account the aerodynamic resistance of air to the horizontal movement of a cotton ball, determined the law of motion of cotton in a pipe and put forward the idea that cotton can be separated from air using inertial force. Based on the results of the conducted research, cotton separation 1350 hectares It is scientifically proven that it occurs at an equal angle of rotation, and at the same time the flow velocity is 16 m/s.

Muradov R. In [14], the behavior of cotton on cone-shaped mesh surfaces was studied. According to the author, one of the main disadvantages of the transport device with the help of air flow is the high energy consumption in the cotton transportation process.

In the work of R. Muradov [15], the main reasons for cotton getting stuck between the blades of a vacuum valve and the walls of the chamber were studied.

General analyses show that the physical, mechanical and aerodynamic properties of cotton affect the process of separating it from air and that they should be taken into account when creating new separator designs.

Cotton enters the working chamber of the separator with an air stream. The main part moves straight in the working chamber of the separator, hits its walls, and falls under the influence of its own weight to the vacuum valve. The remaining part hits the mesh surface. Circular mesh surfaces are installed on the sides of the separator working chamber in the path of the air flow. A certain part of the cotton sticks to these surfaces. The installation of the mesh surface in a rotating manner makes it difficult for the cotton to settle on its surface. Also, the coefficient of friction between the moving support surface and the object on its surface is lower than that on a stationary surface. Therefore, when the mesh surface rotates, the cotton is forced to move outward from the surface under the influence of gravity and centrifugal forces. Part of the cotton falls off the mesh surface under the influence of these two forces. The rest is separated using a stationary separator.

The equation of motion of a piece of cotton in the polar coordinate system looks like this:



$$\left. \begin{aligned} m\ddot{r} &= -G \sin \varphi - F_i \cos \varphi + F_m \\ \varphi &= \omega t \end{aligned} \right\} \quad (1)$$

Here, $G = mg$ – weight strength of cotton, N; m – mass, kg; F_i – friction force, N; – centrifugal force, N; – angle of rotation of the surface, rad; – angular velocity, rad/s; -time, s. F_m

$$\varphi = \omega t$$

The equation of motion of a piece of cotton in the polar coordinate system looks like this:

$$\left. \begin{aligned} m\ddot{r} &= -G \sin \varphi - F_i \cos \varphi - F_{is} \cos \varphi + F_m \sin \beta \\ \varphi &= \omega t \end{aligned} \right\} \quad (2)$$

Here, F_{is} The coefficient of friction of cotton with an absorbent surface. It is found as follows:

$$F_{is} = fN$$

We determine the force N of the impact of the cotton ball on the eraser:

$$N = mg \cos(\omega t + \phi) f_1 P_x \frac{r\omega}{\sqrt{r^2 + r^2 \phi^2}} \geq 0 \quad (3)$$

Putting the result in (2.39) and after some transformations, we get:

$$\left. \begin{aligned} m\ddot{r} &= -mg \sin \varphi - \left[mfkvx + fmg \cos(\varphi - \beta) f_1 \frac{r\omega}{\sqrt{r^2 + r^2 \phi^2}} \right] \cos \varphi + mr^2 \varphi \sin \beta \\ \varphi &= \omega t \end{aligned} \right\}$$

Theoretical analyses of the process of separating a cotton sliver from a mesh surface from the literature show that under the influence of the absorbent, the cotton moves in a circular motion along the mesh surface in a radial direction from the center to the periphery, and its trajectory has the form of a spiral. It can also be concluded from these trajectory lines that if the holes on the surface are formed in the form of grooves corresponding to these trajectories, the resistance to their movement will decrease dramatically. From this point of view, the idea of forming the separator mesh surface in the form of a spiral from a steel wire or strip expanding radially from the center was born, and a technical solution based on this was developed.

Results

Experiments were conducted on the proposed separator, the appearance of impurities and defects in the technological process was determined, and samples were taken from the gin, the existing SS-15A separator, and the fibers after the



proposed separator, separating the cotton from the chaff, and the results of the research are shown in Table 4.3. The experiments were carried out in the HVI 900 SA instrumental laboratory system, which is designed to determine the fiber quality indicators according to the international universal cotton fiber standard. The terms and quality indicators in the HVI 900 SA instrumental laboratory system for fibers of the Andijan-35 selection variety are given based on the international universal cotton standard.

After the inclined mesh installed in the working chamber of the separator machine was tested, it was determined that positive results were obtained based on the results of testing fiber samples on the HVI-900SA laboratory system at the laboratory center of the Namangan regional branch of the State Enterprise "Agro-Industrial Complex Service Center".

For example, the Mic - Microneural fiber parameters did not change, Str - relative breaking strength decreased from 38.9 gs/tex in the existing separator to 36.5 in the new one, to 38.8 gs/tex, SFI - short fiber content increased from 2.6 in the existing separator to 3.4 in the new one, to 2.7%, Elg - relative elongation at break decreased from 6.9 in the existing separator to 6.0 in the new one, to 6.7 in the new one, Cnt - the amount of impurities decreased from 18 units in the existing separator to 15 units in the new one.

The positive results obtained are the result of the reduction of impact forces on the cotton in the new separator, the creation of the possibility of additional cleaning of the cotton, and the elimination of cotton getting stuck between the vacuum valve wings and the wall.

Quality indicators of cotton fiber samples obtained after the gin and separator were determined using the HVI 900 – SA laboratory system

Table 1

N o.	The name of quality indicators in the international universal standard system of cotton fiber	S 65-24 selection grade cotton fiber		
		Natural quality indicators of cotton fiber	Fiber from the existing SS-15A separator	Fiber from advanced separator equipment
1	Mic Microneur	4.4	4.1	4.4

2	Str Relative breaking strength, gs/tex	38.9	36.5	38.8
3	Len Upper average length, inches, mm	1.18	1.15	1.18
4	Unf. Uniformity index along the length, %	83.6	83.1	83.5
5	SFI- Short fiber content, %	2.6	3.4	2.7
6	Elg - Relative elongation at break, %	6.9	6.0	6.7
7	Trash Dirty code	4	2	2
8	Cnt Contaminant quantity	18	15	14
9	Area of impurities	0.9	0.8	0.8
10	CG Sort by color	31 – 4	31 - 4	31-4
11	Rd- fiber reflection coefficient, %	75.1	75.1	75.1
12	+b Fiber yellowness level	8.6	8.6	8.6

Discussion

An analysis of the relevant scientific literature has shown the need to identify a number of shortcomings of existing separators and conduct research on additional cotton cleaning in the separator, reducing mechanical damage to cotton and fiber loss.

Based on theoretical studies, the laws of air parameters change in the pneumotransport system depending on the pipe diameter, different constructions of the transition parts of the pipe, and different initial parameters of the fan have been determined. As a result of studies of the movement of cotton along the surface of the moving mesh of the separator, the effect of the speed of rotation of the surface, the angle of deviation of the fixed strainer in the vertical plane on the speed of cotton leaving the mesh surface was determined.

As a result of theoretical and practical research, a separator design with a rotating mesh surface and a fixed wiper was created. As a result of studying the dynamics of cotton interaction with a moving mesh surface, the trajectory of cotton



movement, the time of its interaction with the mesh surface, and the rational value of the angle of inclination of the fixed wiper relative to the vertical axis of the mesh surface were determined.

When a production model of the new separator equipment was tested under production conditions at the Kosonsoy Cotton Cleaning Enterprise, it was found that the amount of impurities in cotton was reduced by 1.2%, and the damage to the seed was reduced by 1.7% (in absolute value) compared to the current situation.

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