International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 04, 2020
ISSN: 1475-7192

Ways to Reduce the Impact of Cotton in the Separator Worker Chamber

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Abstract--- *The article describes the transfer of cotton to the next technological process while preserving its natural properties during the initial processing process. The analysis of ways to reduce shock forces during the removal of cotton seeds from the air was analyzed. For this purpose it is based on the first cotton processing of cotton.*

Keywords--- *Quality, Cotton, Fine Impurities, Impact Strength, Transport, Damage, Working Chamber, Impact Strength, Cleaning, Seeds, Fiber, Pipe.*

I. INTRODUCTION

One of the main tasks of modern production is to increase the production capacity of the republic, the efficient use of resources and the quality of work.

Today, one of the main requirements for the technological process of cotton processing is to obtain high-quality fiber by processing, while retaining the natural properties of this valuable raw material.

Many researchers have found that the ability to increase fiber output can also be achieved during the cotton processing process by upgrading the pneumatic transport system from the air and improving the working elements of the device. Numerous theoretical and practical studies have been carried out on separation of cotton from the air and vacuum-coupling of the cotton in the separator, but nowadays the technology and technology, which fully meet the modern requirements, remains relevant. This is because no universal technology has been developed to prevent the damage of the cotton seeds from the air and to remove impurities, thereby increasing the fiber output.

Taking into account the above, the authors conducted a study on the preservation of natural properties of cotton products in separator equipment. As a result of the research, about 1.6-1.8% of seeds are damaged during transportation and cleaning of the cotton from piles to main shops. Therefore, the main focus of researchers engaged in air transportation and purification of cotton in pipelines is to investigate and reduce the damage to seeds [1-3].

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DOI: 10.37200/IJPR/V24I4/PR2020458
Received: 12 Mar 2020 | Revised: 25 Mar 2020 | Accepted: 10 Apr 2020

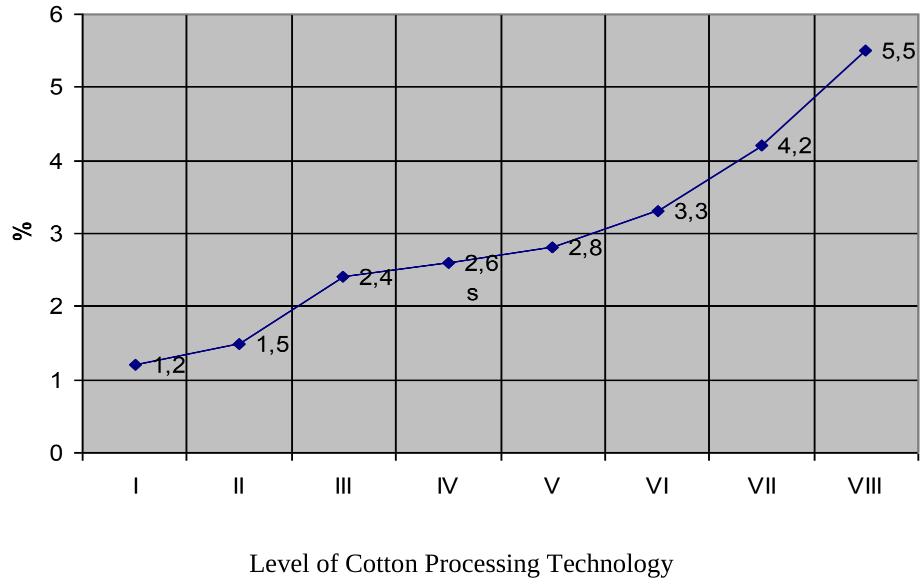

Figure 1: The Degree of Damage to the Seed in the Technological Process

Seed damage studies showed that the selection variety was 108-F, I-sort, hand-picked cotton, seed cotton with a moisture content of 9.2% and a contamination level of 1.2%. During the processing of seed cotton, the speed of raw cotton in pneumatic transport is 24-26 m / s. In the research work, samples were taken for analysis at eight points of the technological process of cotton processing. In the process of storing I-seed cotton in the bale, at the first turn of II-pneumatic transport, after III-SS-15A separator equipment, after IV-drying-cleaning shop, after V-SS-15A separator equipment, after VI-sorting process, VII -After lintering, samples were taken from the processes after VIII-delinterization. The results of the sample show that the maximum damage to the seed was increased by 2.5-3% in the area between ginning and lintering processes (V-VIII). Up to 1.5% of seed damage was observed in the area (I-VI) between the ginning process of seed cotton storage. It has been proved that 1.0-1.2% of cotton seed damage occurs during transportation of raw cotton by pneumatic transport.

It is known that one of the main elements of the device for transporting cotton by air is a separator. The separator is used to separate the raw cotton from the incoming air. Improving the efficiency of the technological process, productivity, maintaining the quality of cotton by improving the separators used in ginneries is one of the urgent tasks.

In the existing separator device in the ginnery, during the descent into the vacuum valve, its blades are hung on the ends and squeeze the device into the body. As a result, the raw cotton remaining between the vacuum valve blade and the housing is damaged.

The raw cotton is punched into the working part of the wall of the working chamber in front of the separator inlet pipe and the raw material is damaged.

Accordingly, the author proposed the following separator designs in order to prevent damage to the separator equipment.

DOI: 10.37200/IJPR/V24I4/PR2020458
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II. A Method Of Improving The Quality Of Raw Materials In Cotton Processing, Separator Equipment

Pneumatic transport is connected to a continuous technological process in all shops of the plant, and its normal operation greatly influences the efficiency of the shops. In addition, the air separator can be hit by a wall in front of the separator inlet and the raw material will be damaged. From the foregoing, to avoid this, studies were performed simultaneously on separation equipment to remove minor impurities (Figure 2).

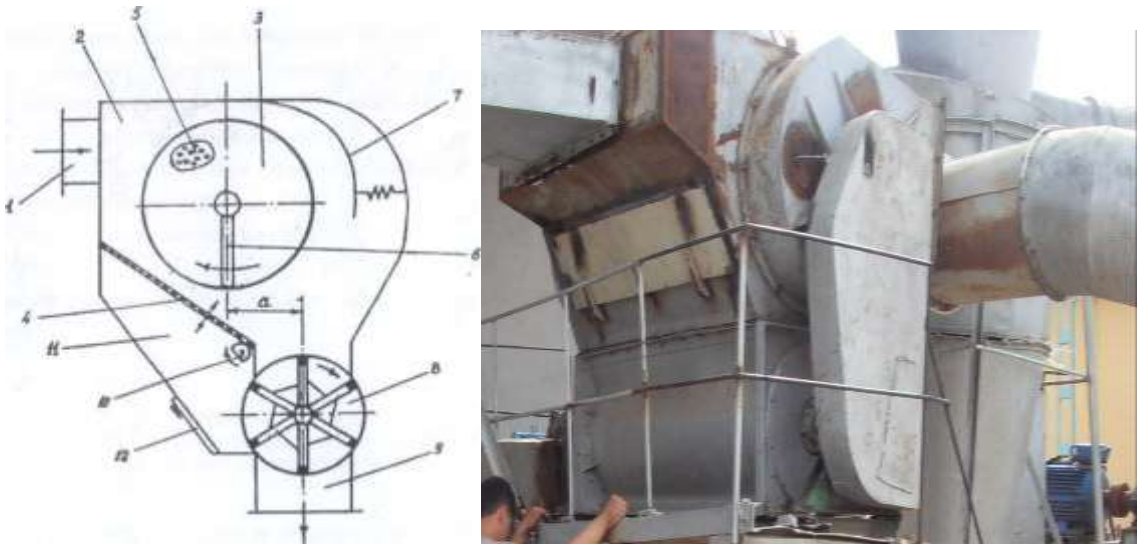

Figure 2: Cotton Separator (Patent №IAP 03325).

1-inlet pipe; 2-separation camera; 3-air camera; 4-cleaning mesh surface; 5-mesh surface; 6-scrapper; 7- referral plate; 8-vacuum valve; 9-outlet pipe; 10-vibrating tappet; 11-dirt collection pockets; 12- pollutant discharge pipeline.

This improved separator works as follows: Cotton raw materials mixed with air enter separating camera 2 through the inlet pipe 1. Because the separating camera 2 is wider than the inlet pipe 1, the velocity of the cotton falls and the bulk of the raw material hits the vacuum-valve 8 by hitting the cleaning net 4, the router 7 and the other with the separation lattice. The adhesive cotton scraper is removed by 6, and they are also transmitted to vacuum valve 8. Dust flows through the air unit 3 to the cyclone. The cotton vibration valve, which has been lowered to the surface of the cleaning net 4, is released on the lattice surface 10 through the vacuum-valve 8 and purified from exhaust pipe 9. Minor impurities are collected at pipe collection pile 11 and discharged through the pipe 12.

The advantage of the separator being proposed is that it simultaneously separates cotton from the air, removes minor impurities, and prevents damage to the separator wall of the seeds and fibers [5, 6, 7]. Due to the proposed changes, the quality of cotton will be prevented when it is delivered to processing machines. As a result, the raw materials are not damaged, and the fiber does not appear in any defects. Due to the quality improvement, the enterprise will be able to achieve significant economic effect. It is also recommended to install materials in places where the damage to the seeds can be damaged by the shock reduction separator and cotton cleaning machines. This

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will improve the quality of the fiber by reducing the amount of defects in the fiber and will be able to sell it in the highest grade.

III. THEORETICAL STUDY OF THE IMPACT OF INCOMING COTTON ON THE SPRING PLATE, ENTERING THE WORKING CHAMBER OF THE SEPARATOR

Studies have shown that 1.2-1.7% of seed damage occurs as a result of impact on the walls of the device during the movement of cotton swabs inside the pipes of the air-carrying device. This, in turn, leads to the formation of defects in cotton fiber from 0.3 to 0.4% [8, 9, 10, 11].

Therefore, the authors propose that a liner should be placed below the inlet pipe, which is to clean the surface of the raw material in the separator system from high dirt. This orientation improves the efficiency of cleaning out minor impurities.

The authors theoretically studied the impact of incoming cotton on the spring plate, entering the working chamber of the separator.

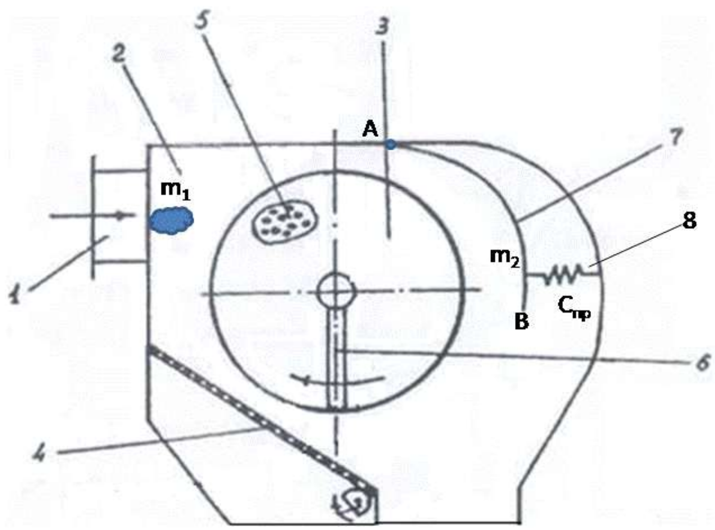

Figure 3: The Movement of Cotton in the Separator Working Chamber

1-inlet pipe; 2-separation camera; 3-air camera; 4-cleaning mesh surface; 5-mesh surface; 6-scrapper; 7- referral plate; 8-spring.

A dynamic force R_{din} is created as a result of the impact of a piece of cotton of mass m_1 entering the working chamber of the stone catcher with the speed V_1 in the middle of the AB plate, and we determine it by the following formula:

$$P_{din} = kP_{st} \qquad (3.1)$$

Here: k - dynamic coefficient; P_{st} - static force.

The dynamic coefficient is calculated according to the following law (3.2) according to the law of conservation of energy.

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$$k = 1 + \sqrt{1 + \frac{v_n^2}{g\Delta_{st}(1 + \frac{m_2}{m_1})}} \qquad (3.2)$$

In this case:v_n - speed of cotton m / s; g - free fall acceleration m / s^2; Δ_{st} - deformation under the influence of static force m; m_1 - mass of a piece of cotton in kg; m_2 - the mass of the plate, kg.

The deformation caused by static force is obtained as the sum of the corresponding deformations of the spring and the plate, that is

$$\Delta_{st} = \Delta_{\text{springs}} + \Delta_{plate} \qquad (3.3)$$

In this case: Δ_{springs} - static deformation of the spring; Δ_{plate} - static deformation of the plate.

Static deformations of the spring and plate are calculated by the following formulas under the equilibrium conditions of statics:

$$\Delta_{st} = \frac{8D^3n}{cd^4} \qquad (3.4)$$

$$\Delta_{plate} = \frac{Pl^3}{48EJ_y} \qquad (3.5)$$

In this case: D - the large diameter of the spring; d - the small diameter of the spring; n - the number of packages; s - the coefficient of elasticity of the spring; R - the force acting on the plate; l - the length of the plate; J_y - moment of inertia; E - modulus of elasticity.

Static force is determined using the following formula:

$$P_{st} = m_1 g + m_2 g \qquad (3.6)$$

In this case: m_1 - the mass of a piece of cotton; m_2 - the specified mass of the plate; g - acceleration of free fall, m/s.

IV. RESULTS

The resulting deformation of the spring and the change in the amount of dynamic force generated as a result of changing the small and large diameters of the spring obtained as a result of the studies are shown in Table 1.

DOI: 10.37200/IJPR/V24I4/PR2020458
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Table 1: The Effect of a Change in the Diameter of a Spring on its Deformation and a Change in the Amount of Dynamic Force

№	*D*mm	*d*mm	*n*	v_n	Δ_{st} $\Delta_{strings}$	c - the coefficient of elasticity of the spring	ΔK_g dynamiccoefficient	P_g dynamicstrength, H
2	30	3	12	10	0,45	1,25	2,48	461,3
1	40	4	12		0,35	1,6	2,59	481,7
4	16	2	12		0,35	1,6	2,59	481,7
3	24	2,4	12		0,6	0,9	2,38	442,7
2	30	3	12	12	0,45	1,25	2,65	493
1	40	4	12		0,35	1,6	2,79	519
4	16	2	12		0,35	1,6	2,79	519
3	24	2,4	12		0,6	0,9	2,51	467
2	30	3	12	14	0,45	1,25	2,83	526,4
1	40	4	12		0,35	1,6	3	558
4	16	2	12		0,35	1,6	3	558
3	24	2,4	12		0,6	0,9	2,66	494,8
2	30	3	12	16	0,45	1,25	3,01	559,9
1	40	4	12		0,35	1,6	3,22	598,9
4	16	2	12		0,35	1,6	3,22	598,9
3	24	2,4	12		0,6	0,9	2,81	522,7
2	30	3	12	18	0,45	1,25	3,21	597,1
1	40	4	12		0,35	1,6	3,45	641,7
4	16	2	12		0,35	1,6	3,45	641,7
3	24	2,4	12		0,6	0,9	2,98	554,3
2	30	3	12	20	0,45	1,25	3,4	632,4
1	40	4	12		0,35	1,6	3,67	682,6
4	16	2	12		0,35	1,6	3,67	682,6
3	24	2,4	12		0,6	0,9	3,14	584

Analyzing the results obtained in Table 1, we saw that the change in the large diameter and small diameters of the spring did not change the amount of dynamic force by a small amount. Therefore, when choosing it, it is possible to get a spring that is easy to install.

According to the results of the study, the change in spring deformation and the amount of dynamic force, depending on the geometric dimensions (Table 1), as well as the number of windings, are shown in Table 2.

Table 2: The Effect of the Number of Spring Windings on Its Deformation and the Change in the Amount of Dynamic Force

№	*D*mm	*d*mm	*n*	v_n	Δ_{st} $\Delta_{strings}$	c - the coefficient of elasticity of the spring	ΔK_g dynamiccoefficient	P_g dynamicstrength, H
5	30	3	10	10	0,38	1,5	2,55	474,3
1	30	3	15		0,57	1	2,39	451,7
2	30	3	8		0,3	1,87	2,67	496,6
3	30	3	6		0,22	2,5	2,86	531,9
4	30	3	20		0,76	0,75	2,31	429,7
5	30	3	10	15	0,38	1,5	3,05	567,3
1	30	3	15		0,57	1	2,77	515,2
2	30	3	8		0,3	1,87	3,24	602,6
3	30	3	6		0,22	2,5	3,55	660,3
4	30	3	20		0,76	0,75	2,61	485,5
5	30	3	10	18	0,38	1,5	3,36	439,5
1	30	3	15		0,57	1	3,01	559,9
2	30	3	8		0,3	1,87	3,6	669,6
3	30	3	6		0,22	2,5	3,99	742,1
4	30	3	20		0,76	0,75	2,8	520,8
5	30	3	10	20	0,38	1,5	3,58	479,9
1	30	3	15		0,57	1	3,18	591,5
2	30	3	8		0,3	1,87	3,86	717,9
3	30	3	6		0,22	2,5	4,3	799,8
4	30	3	20		0,76	0,75	2,96	550,6

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According to the results obtained in Table 2, when changing speed of air, it was found that the amount of dynamic force can change significantly. It was therefore determined that it was advisable to increase the number of packages as much as possible.

The amount of spring deformation and dynamic force depends on the geometric dimensions of the spring as well as the number of turns. When the number of springs of the spring was changed, the amount of dynamic force changed significantly. Therefore, the number of spring coils was chosen to be 20, the outer diameter to be 30 mm, and the diameter of the spring metal to be 3 mm. Studies have shown that the spring plate significantly reduces the impact force and does not damage the seed.

In an air-carrying device, the variation of the distance between the drying and cleaning shop and the bales causes the speed of the cotton moving in it to change. Therefore, the velocity of the air in the tube was changed. The results obtained are presented in Table 3.

Table 3: The Effect of Changes in Air Velocity on Changes in the Amount of Dynamic Force

№	*D*mm	*d*mm	*n*	v_n	Δ_{st} $\Delta_{strings}$	c - the coefficient of elasticity of the spring	ΔK_g dynamiccoefficient	P_g dynamicstrength, H
1	30	3	10	8	0,38	1,5	2,75	31,51
2	30	3	10	10	0,38	1,5	3,06	35
3	30	3	10	15	0,38	1,5	3,88	44,38
4	30	3	10	20	0,38	1,5	4,74	54,23

Thus, in Table 3, a speed of 15 m / s in which the cotton could move more in the separator chamber was selected, and it was found that the amount of dynamic force generated in it was 1.5 times less than the amount of force that could damage the seed.

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.

V. Conclusion

This paper identifies the relationship between the number of windings of the spring mounted on the working chamber and the dynamic force in order to reduce seed damage in the separator. Using this bond,it is possible to reduce the impact force generated by the cotton hitting the walls of the working chamber to a level that does not damage the seed. Theoretically and practically determined, the number of springs of the spring is 20, the outer diameter is 30 mm, and the diameter of the spring metal is 3 mm. If the selected one is used in the remaining 2-3 separators installed in the enterprises, the degree of damage will be eliminated. As a result, the formation of defects in the fiber content is reduced. If this new equipment is introduced into the technological process of the enterprise, there is a possibility that ordinary fiber will be better and even fiber with good performance will be higher. As a result, the economic efficiency of the enterprise will increase significantly.

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DOI: 10.37200/IJPR/V24I4/PR2020458
Received: 12 Mar 2020 | Revised: 25 Mar 2020 | Accepted: 10 Apr 2020