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THEORETICAL RESEARCH OF THE EFFECT OF DAMAGE AND AIR TRANSPORT WORKING PARTS ON COTTON RAW MATERIALS

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Abstract
The article reflects the results of the creation and analysis of a new design of the process of breaking the cotton gin with the help of a gin. The processes of formation in the layers in the process of interaction between the working bodies of the ginnery and the cotton gin were theoretically analyzed, the equation of motion of the cotton piece was obtained using the Euler equation and analyzed in the program Maple-2015.

Keywords: raw cotton, pile parser, cutter, chopping, pneumatic installation, the friction force, the conveyor belt.

Introduction
The introduction of new technologies every minute serves to improve the quality of products and the efficiency of machines. The future achievements of the company are the most pressing issues today - the processing of existing raw materials at the level of world standards, the improvement and development of resource-saving technologies for the production of competitive products in the domestic and foreign markets [1-7].
In order to increase the number of export-oriented products to each manufacturer, to introduce new models of cars from developed countries through the introduction of benefits and create vacancies, to introduce convenient transit routes for exporters, to remove artificial barriers for export-oriented products. regional and republican export headquarters were established. As a result of the introduction of discounts and

subsidies on customs duties, depending on the type of export-oriented products, the level of trade turnover in the country is increasing.

From the created opportunities, the republic's industrial enterprises, including the enterprises of cotton and textile clusters, are facing many challenges [8-13]. Today, all the machines installed in the flow line of ginneries that are part of the cotton textile cluster depend on the efficiency of the spinning machine.The proper operation of the equipment of the enterprise depends on the scientific organization of the work process of the commodity zone 1, which is responsible for the receipt of raw cotton. The received raw cotton is stored in open and closed warehouses, and the flow is carried out using RP, RBX, RBA balers in the set of pneumatic transport system at the beginning of the line. The function of this machine is to break up the seed cotton bale and transfer it to the pneumatic conveyor pipe via a belt conveyor [14-19].

The negative impact of cotton and its components on the initial quality indicators depends on the level of contamination and moisture in the product. Because the high-moisture seed cotton piles hit the fiber and the seed, the piles rotate along an arc equal to the height of the sloping piles made to prevent fiber damage with tergens that increase the strength of the piles.

The constructive positioning of the mechanically actuated ring pile means that the clamp must move back and forth during the crushing process and during the transfer to the pneumatic transport pipe. In order to reduce the need to continuously increase or decrease the length of the pipe, an auxiliary belt conveyor is installed parallel to the line of motion of the pipe [1,2,3]. Figure 1 shows a schematic of the working process of the grinder.

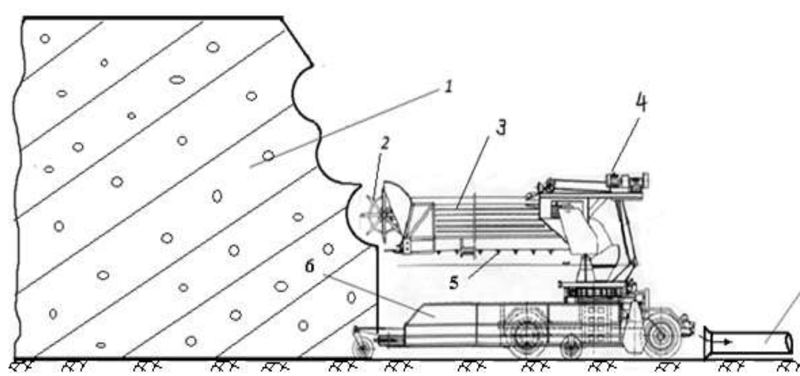

Figure-1 Mechanical spoiler is an overview of the supplier.
1 - gharam, 2 - chambarak; 3-arrow; 4- arrow lifting mechanism; 5- a conveyor carrying cotton from the bale; 6 - auxiliary belt conveyor, 7 - pipe.

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In the process of taking the baled cotton from the bale and transferring it to production, the bale is placed in the middle of the small-sized side of the bale and begins to break the bale from the top of the bale. The hoop, located on three parts of the equipment axis, rotates from top to bottom, passing the cotton pieces separated from the bale to the conveyor belt. The conveyor belt carries the separated cotton pieces to the cotton picker. The conveyor belt conveyor located below it throws the cotton to the side, the conveyor belt to the horizontal conveyor. He in turn throws the cotton into the air transport pipe.

Theoretical research of the process of destruction of a new construction

Practical research shows that, in general, high productivity (11.6 kg / s) the unevenness index is also relatively hig (1.8-2.5 kg / s), ower (8.4 kg / s) lower in productivity (1-1.8 kg / s) determined to be. Low density of cotton (results of series 1 experiment, 1.2-1.8 kg / s in the layer of the pile at a distance of 0-2.5 m from the top) is also low, high density (series 3 experiments, in the layer of the pile at a height of 2.5 m from the ground - Up to 2.5 kg / s). The clogging of the air duct and separator with cotton, the clogging of the stone pockets with cotton correspond to the high rates of unevenness.

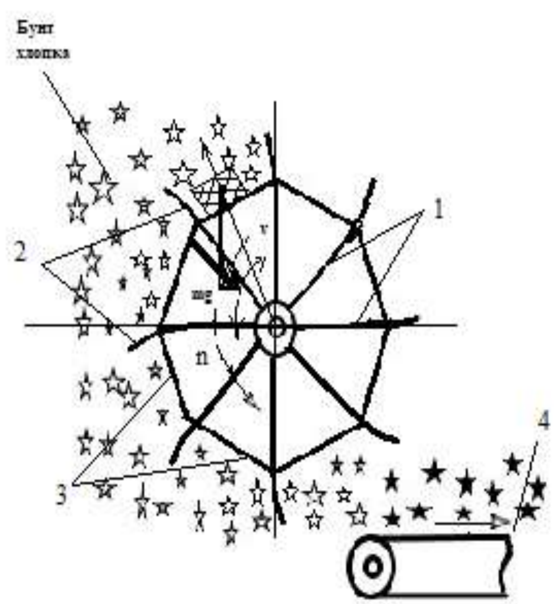

Figure 2. Schematic of the process of breaking the cotton ball of the spool ring. 1 radial rods, 2 pegs, 3 connecting rods, 4 conveyor belt

Studies have shown that the non-uniform transmission of cotton is caused by the design and technological parameters of the ginnery, which in turn damages the cotton seed to a certain extent. Although these shortcomings are explained in practice by the strong impact effect on the machine and the constructive features of the machine working bodies, the above shortcomings have not been theoretically explained as a result of insufficient theoretical study of the process. In order to clarify this issue, the process of mechanical breaking of the pile and the movement of the cotton mass between the piles were studied [21-28]. To do this, the process was assumed to be stationary, given the situation in which the hoop was fully immersed in the cotton ball. In this case, the process is repeated periodically over a period of time. The process diagram is shown in Figure 2. Using the Euler equations for the stationary process, we study the change in density, pressure, and velocity of the cotton mass along the arc length filled with the cotton mass.

We will mark:

$v_1(м/c),\ \rho_1(кг/м^3),\ p_1(H/м^2)$ the speed, density, and pressure of a piece of cotton, respectively, in an arbitrary section, S-segment of the separated element, - the angle of inclination of the plane of the heap, φ- OA angle varying from radius, k- side pressure coefficient, $f=((f_p+f_c)/2$, f_p - between the separated raw cotton and the immovable (haram) cotton, f_c and the coefficients of friction between the rod connecting the piles and the cotton, L - the contour length of the cutting surface of the part to be separated,

$ds = Rd\varphi$ ds bow of action, R – pile length, m.

According to the equation of motion of the pieces of cotton between the piles:

$$\rho_i v_i \frac{dv_i}{d\varphi} = -\frac{dp_i}{d\varphi} + \rho_i gR[\sin(\beta-\varphi) - f\cos(\beta-\varphi)] - kfLRp_i/S - f_p \rho_i v_i^2$$

$$(i-1)\varphi_0 < \varphi < i\varphi_0 \quad i = 1,2,3,4 \qquad (1)$$

The linear relationship between pressure and density in each section:

$$\rho_i = \rho_k[1 + B\cdot(p_i - p_k)], \ (i = 1,2,3,4) \qquad (2)$$

According to the law of conservation of mass:

$$\rho_i v_i S = \rho_k v_k S = Q_0, \ (i = 1,2,3,4) \qquad (3)$$

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Here, ρ_k, v_k and p_k are the corresponding densities, velocities, and pressures of the cotton mass moving on the lower surface of the piles;
In this case (2) - the equation of state of the environment - the relationship of pressure and density, ($B(м^2/H)$ – experimental size), (3) – the law of conservation of mass per unit time; Q_0 - work productivity
$B << 1$ when:

$$v_i = \frac{v_k}{1+B(p_i - p_k)} \approx v_k[1 - B(p_i - p_k)], \quad (i = 1,2,3,4) \quad (4)$$

$$\frac{dp_i}{d\varphi} = p_i F_1(\varphi) + F_2(\varphi), \qquad (i = 1,2,3,4) \quad (5)$$

Here, $a = 1 - \rho_k v_k^2 B$, $F_0 = \cos(\beta - \varphi) - f\sin(\beta - \varphi)$.

$$F_1 = [\rho_k gRBF_0(\varphi) - kfLR/S + f_c\rho_k v_k^2]B, \quad F_2 = \rho_k gRF_0(\varphi)(1 - Bp_k) - f_c\rho_k v_k^2(1 + Bp_k).$$

(5) equations are integrated under the following conditions:

$$p_i = p_k => \varphi = \varphi_i = (i-1)\varphi_0, (i = 1,2,3,4); \; p_k = p_1 - \frac{1}{B}(\frac{v_k}{v_l} - 1), \quad (6)$$

Density of cotton in the tape: $\rho_l = \dfrac{Q_0}{v_l S_l}$ (7)

Here is the cross-sectional area of the thickness of the raw material layer in the tape.

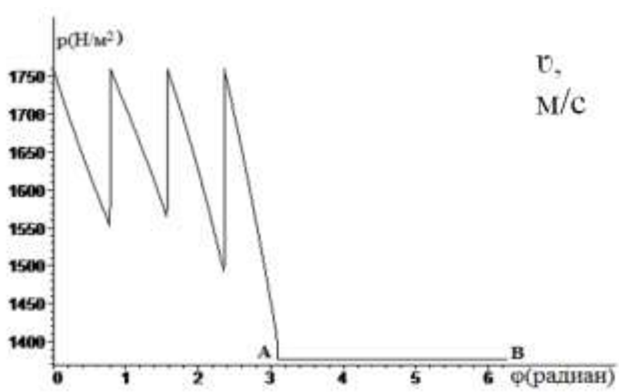

Figure 3. Distribution of cotton mass pressure across the interaction zone with the piles and the tape surface (AB)

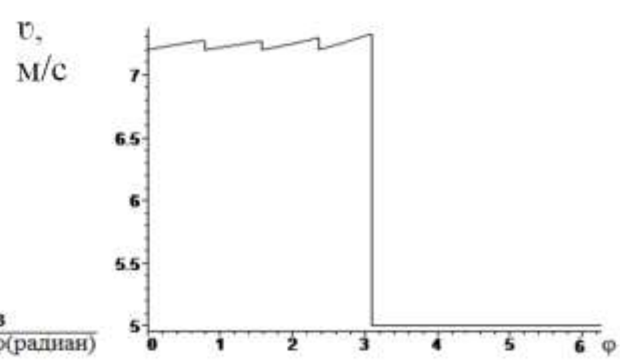

Figure 4 The change in velocity of the cotton mass along the zone of interaction with the pegs and the tape surface (AB)

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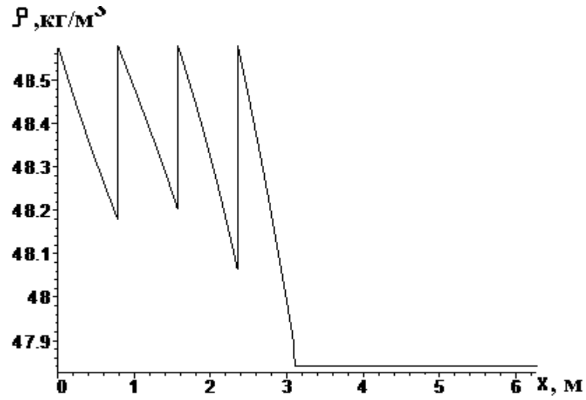

Figure 5. Variation of cotton density along the zone of interaction with the piles and the tape surface (AB)

Figures 3-4 show the change in pressure, velocity, and density of the cotton raw material along the zone of interaction with the piles and the tape surface. The calculations were performed in Maple 2015 at the following values: $f_p = f_c = 0.3$ $\varphi_0 = 45^0$, $B = 0.00005 \Pi a^{-1}$, $Q_0 = 12000$ kg/h; $L = 0,3m$. $h = 0.04m$, $R = 0.55m$, $v_0 = 7.2 m/h$, $v_1 = 5 m/h$, $k = 0.6$,.

Similarly, if we observe the change in the velocity of the cotton mass along the zone of interaction with the piles and the surface of the tape (AB) in Figure 4, we can also see a jump change in the velocity parameter. Indeed, when each peg is hit by a pile, the speed of the cotton mass undergoes a sharp change as they are fastened to a single base (i.e., a hoop). After the 5th pile, the speed of the cotton decreases sharply and it takes over the speed of the conveyor belt [29-37]. Figure 5 shows the change in the density of the cotton mass along the zone of interaction with the piles and the tape surface (AB). If you look at these graphs, you can see that the situation in figure 5 is reversed.

Indeed, when the first pile hits the cotton ball, the pressure exerted by the pile compresses the piece of cotton and the density increases sharply. Calculations show that the maximum density of cotton is 48.6 kg / m^3 in the current parameters. In the pile spacing, the density decreases to 48.2 kg / m^3. When the 2nd pile is hit, the density rises to the maximum value again and decreases sharply again.

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Analysis of the reaction forces produced in the cotton layer

It is known that in the separation of cotton from the stacked cotton layer, a reaction force is created that acts on the coiled pile, which is separated by the stacked layer. According to the law of reciprocity, this force, which causes mechanical damage to the seed, is equal to the impact force generated between the piece of cotton and the peg. In order to reduce the value of this force, we have developed a proposal to bend the ring piles at a certain angle in the direction of rotation. This, in turn, ensures that in the process of separating the cotton from the bale, the piles collide at a certain angle with the layer of cotton in the bale, reducing the resulting impact and adhesion forces.

$$P_k = \frac{1}{B}\left[\frac{\vartheta_k \cdot S \cdot k \cdot \rho_0 \cdot cos\gamma}{Q_u} - 1\right] < P_{chk} \quad , \qquad (8)$$

Here P_k- impact force, Pchk– critical force that breaks down cotton seeds, according to G. Miroshnichenko [80] Pchk=4-4.5H. 25% with backup P_{chk}=3 H we accept. k– the coefficient of filling of the hoop with cotton; Q_u- work productivity, S=L·h the cutting surface of the layer, L-width, h-height; ρ0- initial density, B – experimental coefficient.

In Maple 2015, the following parameters are displayed on the computer:

ϑ_k=7.2 m/s; S=0.45x0.06 m; ρ_0=80-100 kg/m3; k=0.1-0.2; Qu=2.78 kg/s; B=0.003 Pa^{-1} the analysis performed on the values of the angle of inclination of the piles $9.5^0 < \gamma < 12.2\ 0$ indicated that it should be in the range. From a practical point of view, it was found that the angle of inclination of the piles should be 10 - 12 degrees. According to the pressure of the Chambarak piles on the cotton (2.14), it was 1550 Pa at an angle of inclination of 10 degrees and 1500 Pa at 12 degrees.

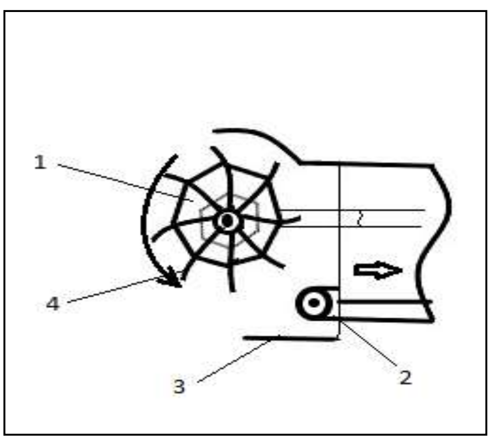

Figure 6. Working diagram of a snail's head

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When analyzing the process of breaking the pile, it was found that the cotton was moved in the form of a large piece as a result of simultaneous biting of the pile parallel pegs with a high-density layer, and it was recommended to install fixed piles (splitters) at the bottom of the pile head.

According to the results of theoretical research, the inclination of the pegs of the ginnery depending on the direction of rotation of the gin = (10 - 12) 0 and the installation of fixed piles (splitters) on the underside of the gutter's head, on the girdle, made it possible to reduce additional grinding and transmission roughness [38-43]. Theoretical research created a working body for crushing large pieces of cotton in a cotton ginning machine, a new design of a pneumomechanical supplier to supply pneumatic transport equipment with cotton, metal pipes with an inner diameter of 355 and 315 mm and quick-replaceable, conical end pipes for the moving part of the pneumatic track. an experimental device consisting of standard elements was assembled for practical testing and determination of their rational parameters, and practical research was carried out in real production conditions.

A working scheme was developed to improve the working bodies of the snail (Fig. 6). According to him, the new working body will consist of a ring 1, a belt conveyor 2, a base 3, and fixed piles 4. In this case, the radial rods are around the shaft the flange (bushing) with a diameter of 140 - 160 mm is fastened in an attempt. This allows the radial rods to deflect 10 to 12 degrees relative to the radius. The ends of these rods are fastened with active bronze pegs. Fixed pegs are mounted on a separate rail. It, in turn, is fastened to the base by means of notched (threaded) connection or welding.

The new working bodies of the ginnery were manufactured at the Pop ginnery of ART SOFT TEXT cluser in Namangan region and tested at the Pop ginnery.

According to the test results, the bulk density of cotton is reduced by 5.0 kg / m3, 8%, and 11.9 kg / m3, by 18.3%, to 0.04%, respectively. relative to 12.3% in the case of new elements, the absolute value increases by 0.01% and relative by 2.2%.

The mass fraction of defects and impurities in the fiber produced is 4.49% in the existing technology and 4.32% in the proposed technology.

Conclusion

As a result of theoretical and practical research on the creation of science-based effective technology for the process of breaking the cotton gin, the following conclusions were drawn:

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1. Based on the dynamic analysis of the process of breaking the cotton gin, it was found that the ginning piles interact with the cotton layer at a pressure of 1750 Pa, and this pressure has a negative impact on the initial quality of raw cotton.
2. According to the results of theoretical research, depending on the direction of rotation of the piles of the plow = $(10 - 12)^0$ reduction of the pressure of the piles on the cotton by 150 Pa. allowed additional grinding of the cotton and reduction of unevenness in the transmission.

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