INTERNATIONAL JOURNAL OF TECHNOLOGY AND ACADEMIC RESEARCH

ISSN: 2224-6878 | Pakistan Volume 6, No. 6.

IF: 15.9 | 2026 http://waerasia.org/index.php/ijtar

"THEORETICAL ANALYSIS OF COTTON CLEANING TECHNOLOGY FROM FINE IMPURITIES USING HEATED AIR IN A PNEUMATIC TRANSPORT SYSTEM"

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Introduction

In our republic, comprehensive measures are being implemented to develop the cotton industry, re-equip and modernize cotton ginning enterprises, increase the profitability of the production and processing of raw cotton, as well as ensure the competitiveness of manufactured products, including: Decree of the President of the Republic of Uzbekistan PF-60 dated January 28, 2022 "On the Development Strategy of the New Uzbekistan for 2022-2026", which sets the task of "ensuring the stability of the national economy and continuing the industrial policy of the new domestic product, with the aim of increasing the volume of industrial production by 1.4 times, while increasing the volume of textile industry production

by 2 times." In the implementation of these tasks , one of the most important issues is the creation of resource-saving, high-efficiency cotton cleaning technology that preserves the initial natural quality indicators, including cotton with a moisture content higher than the standard requirement.

The improvement and research of cotton drying and cleaning equipment abroad were carried out by WS Anthony, RM Sutton, RV Baker, PA Boving, JWLaird, VGArude, SK Shukla, TS Manojkumar, DW Van Doorn, BM Norman and others.

Analysis of equipment for cleaning cotton from small impurities in foreign and domestic cotton ginning enterprises shows that today the problems of creating resource-efficient technologies for cleaning machines in cotton industry have not been fully resolved.

The scientific significance of the research work is explained by the fact that it was possible to obtain dynamic and mathematical models representing the motion of the working bodies of cotton gins, and to determine the laws of motion of the working bodies of the recommended machines, parameter correlation graphs, motion modes, and optimal values of technological, kinematic, and dynamic parameters based on numerical solutions to the problems.

The practical significance of the research results lies in improving the designs of cotton cleaners from fine impurities, which ensure the production of high-quality cotton fiber with high productivity due to the intensification of cleaning processes, increasing the working resource, and reducing the consumption of drivers. The technological system of cotton cleaning is improved based on the effective arrangement of the developed designs .

The cotton ginning machine works as follows. From the separator (not shown in the drawing), the cotton raw material is transferred to the shaft 1 , through the heat transfer pipe 2 , hot air passes through the mesh surface of the grid 6 and enters the shaft 1, where the cotton raw material is heated, a buffer drum 3 is installed to prevent the supply drum 4 from being overloaded . The cotton is shaken with the help of a drum with pegs 5 and cleaned of small

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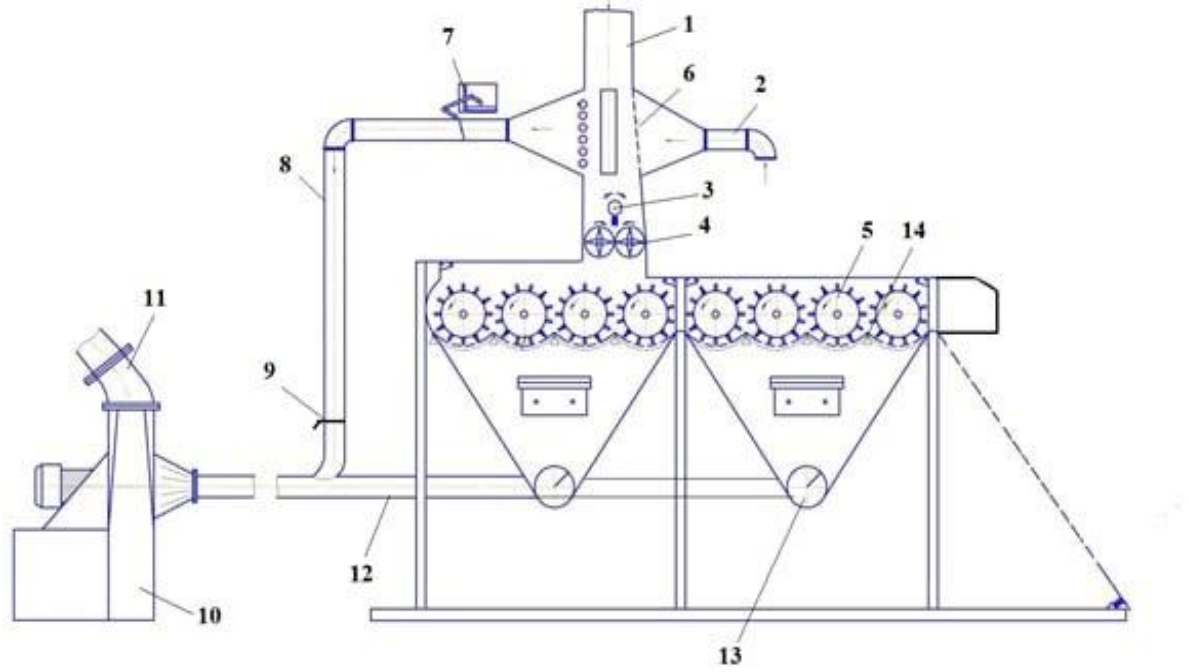
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impurities. The impurities are removed through the grid 14, then the impurities are collected in the auger 13 and
sucked through the pipelines 8 and 12 with the help of a fan 10, and directed to the cyclone through the pipeline 11 (not shown in the drawing).

When supplying air to pipe 8, the air flow rate is adjusted using a regulator 9.

In order to reduce the compaction of the cotton coming out of the mine, a vibrating device made of smooth reinforcement is installed on a 6-mesh surface in the air inlet zone. It penetrates the cotton, reducing its compaction and improving its shaking, thereby improving air circulation.

The proposed high-quality cotton cleaning machine has the following features that increase the cleaning efficiency, i.e., the cotton cleaner from the supply drum falls onto the drum with the third pile and is made to pass hot air during the transfer of cotton to the supplier (Fig. 1). As a result, during the heating process, the raw cotton with increased tendency to swell and split into pieces falls on the third drum, and then it is easier to pick it through the piles. A certain amount of picked cotton is passed from the third drum to the second drum, and from the second drum to the first drum. Cotton begins to move over the mesh surface with a certain amount of tension. Small impurities come out from the cracks of various surfaces.



(Fig 1). A new technological process and equipment proposed for its implementation for cleaning cotton from fine impurities.

1- Shaft, 2- Heat transfer pipe, 3- Buffer drum, 4- Supply drum, 5- Pile drum, 6- Mesh surface, 7- Shutter, 8- Air pipe, 9- Shutter, 10- Fan, 11- Pipe, 12- Dirt suction pipe, 13- Auger for mpurities, 14- Net.

When transporting cotton raw materials on drums, their direction is in accordance with the rotation of the drum, the cotton is blown upwards together with the air. Therefore, the cleaning flaps are reflected from their inner surfaces to the next drums and are repeated, moving in the upper part of the drum in the direction of rotation. This process continues until the barrier of the third drum is reached, transferring the cotton from top to bottom to the mesh surfaces.

As a result of repeated blows of the drums, the cotton is shaken and softened, that is, it is separated into separate pieces, strands, and the tangles of cotton fibers are untied, as a result of which foreign impurities are intensively separated. Part of the separated foreign impurities continues to move along with the cotton pieces, and through the gaps between the drums, the other part of the foreign impurities falls into the waste chamber from the mesh surfaces. In

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addition, the uneven feeding of the feeding drum is smoothed out. In addition, a buffer drum is installed to prevent the cotton balls fed to the shaft from falling onto the feeder and being pressed down.

In the recommended cotton cleaning machine, the cotton is dried with a stream of hot air before being fed into the cleaning working zone, and then transferred through the buffer drum to the cleaning working zone. In this case, the cotton pieces fall onto the buffer drum and, due to their weight, have the opportunity to rotate the drum at different angles. In which part of the cotton pieces are more in relation to the axis of symmetry, the buffer drum is rotated by a certain angle in that direction. Thus, the buffer drum is in eccentric oscillation around its axis. In this case, the cotton pieces are distributed and transferred to the cleaning zone in the appropriate amount. It is important to determine the law of eccentric oscillation of the buffer drum. Because the distribution of cotton pieces depends on this law. We have analyzed this issue from a theoretical point of view. Figure 2 shows a calculation scheme for the interaction of cotton pieces falling from the drying zone with the surface of the buffer drum. In this case, the weights of the cotton pieces are at a certain angle to the axis of symmetry of the buffer drum. Therefore, the value of the gravitational force acting on the drum depends on the value of the drum and the weight of the cotton sliver. Taking into account the individual effect of each cotton sliver, the following expressions can be written: φ_3 ва φ_3^1For cotton slivers in the following state:

$$\vec{G}_3=\vec{G}_{3R}+\vec{G}_{3\tau}\vec{G}_3^1=\vec{G}_{3R}^1+\vec{G}_{3\tau}^1 \quad (1)$$

where: $\vec{G}_3$, $\vec{G}_3^1$– the vector of gravity forces of the 3rd piece of cotton on both sides of the axis of symmetry; $\vec{G}_{3\tau}$,$\vec{G}_{3\tau}^1$the cotton pieces form the vector of gravity force along the radius of the buffer drum, – the vector $\vec{G}_{3\tau}$,$\vec{G}_{3\tau}^1$of gravity forces of the cotton pieces form the tangential direction along the buffer drum.

Therefore, the tangential components of the weights of each cotton sliver along the buffer drum create their own rotating moments. Therefore, differential equations were derived that describe the eccentric motion of the buffer drum:

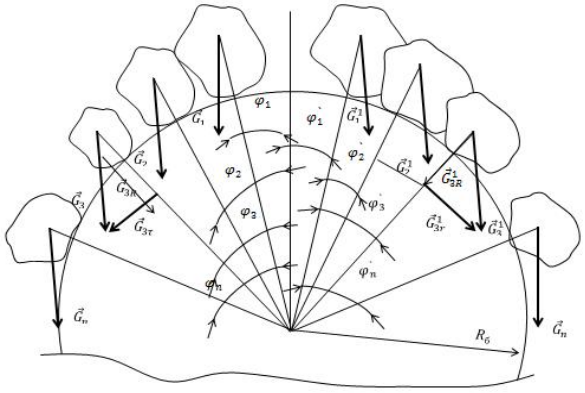
$$J_б\ddot{\varphi}_б=R_бg\left(\sum_{i=1}^{n} m_{1i}\sin\varphi_i-\sum_{i=1}^{n} m_{2i}\sin\varphi_i^{``}\right)-M_{ишк} \quad (2)$$

$M_1>M_2$; бунда $0\le\varphi_1\le\frac{\pi}{3}$;$M_2>M_1$; бунда $0\le\varphi_1^{`}\le\frac{\pi}{3}$

The eccentric frequency of the buffer drum is determined by the angle of rotation. The numerical solution of the example was carried out at the following values of the parameters:

$m_{11},m_{12},m_{13}, m_{21}, m_{22}, m_{23}=(0{,}8\div3{,}0)\cdot10^3$гр;$J_б=(0{,}011\div0{,}26)$кгм^2;

$$M_{ишк}=(8{,}0\div12)\text{Нм};g=9{,}81\ {}^{\text{м}}\!/_{\text{с}^2};R_б=(1{,}0\div2{,}0)\cdot10^{-1}\text{м}.$$

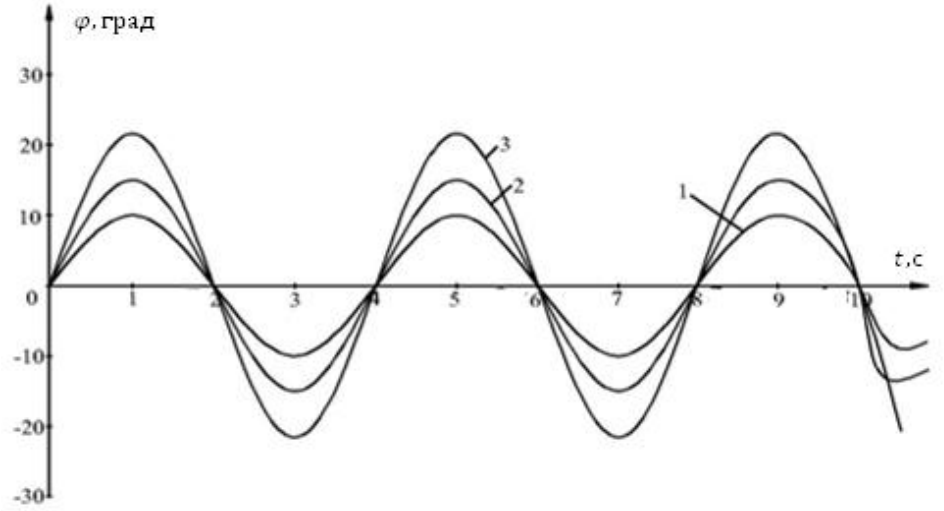


(Fig 2) . Calculation scheme for the impact of cotton pieces on a buffer drum.

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The numerical solution of the problem was carried out on the computer, as a result of which the laws of eccentric movement of the drum were determined, due to the distribution of cotton pieces falling on the surface of the buffer drum by zones. The resulting motion laws are presented in Figure 3.



1−$m_{11}=m_{21}=(0{,}8\div1{,}0)\cdot10^3$гр;2−$m_{11}=m_{21}=(1{,}2\div1{,}4)\cdot10^3$гр;
$m_{12}=m_{22}=(1{,}0\div1{,}4)\cdot10^3$гр;$m_{12}=m_{22}=(1{,}6\div2{,}0)\cdot10^3$гр;
$m_{13}=m_{23}=(1{,}5\div1{,}8)\cdot10^3$гр;$m_{13}=m_{23}=(2{,}2\div2{,}6)\cdot10^3$гр;
3−$m_{11}=m_{21}=(2{,}0\div2{,}2)\cdot10^3$гр;$m_{12}=m_{22}=(2{,}4\div2{,}6)\cdot10^3$гр;
$m_{13}=m_{23}=(2{,}8\div3{,}0)\cdot10^3$гр

(Fig 3) . The law of changing the angle of eccentric rotation of the buffer drum

The analysis of the law of motion of the buffer drum shows that it is eccentrically vibrating around its axis, and the angle of rotation is almost sinusoidal. In this case, falling pieces of cotton are moved due to the alternating effect of the drum relative to the axes of symmetry.

It should be noted that as the mass of the falling cotton pieces changes, the frequency of the eccentric movement of the drum remains almost unchanged, but the amplitude increases accordingly (Figure 3, graphs 1, 2, 3).

The laws of motion resulting from the cotton pieces falling onto the surface of the buffer drum extending from the axis of symmetry by the same amount on both sides are also symmetrical.

In cotton gins, the cotton seeds are pulled by the drum with pegs and dragged through the mesh surface, and the separated impurities fall through the holes in the mesh surface into the discharge zone. In this case, the cotton seeds caught by the pegs are thrown upward at a certain angle depending on their mass and the angular velocity of the drum. The cotton seeds move along a certain trajectory and hit the second drum with pegs. If the cotton seeds have a higher mass, their trajectory will last longer. This is because they are mainly affected by centrifugal force, which depends on the mass and angular velocity. Therefore, the trajectory of the cotton seeds moving between the peg drums is directly related to the moisture content of the cotton.

Using the Dalanbert principle, we derive the following system of differential equations, taking into account the movement of the cotton seed only along the U axis under the equilibrium condition.

$$(m_ч+m_ч^1)\frac{d\left(y+R_б+h_1\right)^2}{dt^2}==(m_ч+m_ч^1)g\cos\alpha+(m_ч+m_ч^1)\omega_б^2\left(R_б+h_1\right)-f_{чк}N+F_б\sin\beta;$$

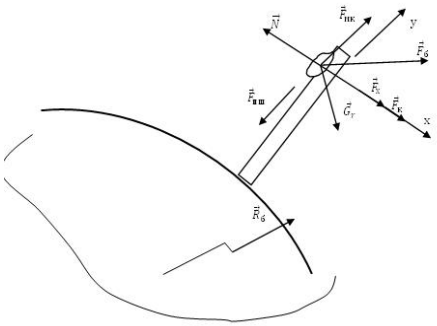
$$N-KV_x^2-2\frac{d(y+R_б+h_1)}{dt}\omega_б\cos\gamma+(m_ч+m_ч^1)g\sin\alpha+F_б\cos\beta=0 \qquad (3)$$

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where, $m_ч$–cottonseed mass; g–acceleration of free fall;
angle between the gravity vector and the u-axis; u is the coordinate of movement along the pile; $R_б$–drum radius; - h_1 distance of cottonseeds on the pile surface; $ω_б$- drum angular velocity; $f_{чк}$- coefficient of friction between cottonseeds and the pile surface; N- reaction force;
$R_б$– the force of attachment of the cotton seed to the cotton pieces and the angle formed by it with the vertical x-axis, K – the coefficient of air resistance; V_x–linear air velocity; t – time. As a result of obtaining a numerical solution to the given system (3), the law of motion of cotton seed along the surface of the drum pile is obtained (Fig. 4).

This issue has been addressed in a number of works, but there have been almost no researches related to the trajectory of sprouting cotton on the surface of the pile depending on its parameters, especially the moisture content of the cotton. Therefore, this issue was considered theoretically.



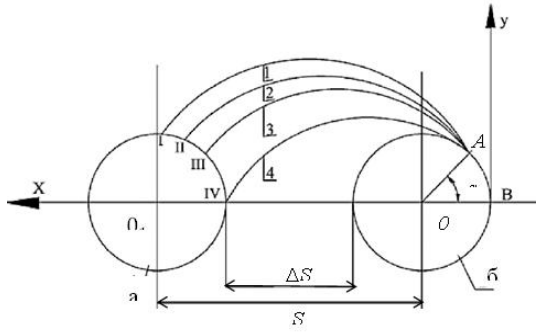
(Fig 4). Schematic Diagram for Pegged Drum Calculations

We determine the trajectory formed by the emergence of seeded cotton from drum piles using the following system of equations:

$$y=y_0+\left(g+\frac{KV_x^2}{(m_ч+m_ч^1)}\sin\alpha\right)\frac{t^2}{2}+V_r\,t\sin\alpha;$$

$$X=X_0+\frac{KV_x^2t^2}{(m_ч+m_ч^1)}\cos\alpha+V_r \quad t \quad \cos\alpha \qquad (4)$$

Let us analyze the derived equation (4). As is known, the distance S between the axes of rotation of adjacent drums with adjacent piles in cotton gins is determined based on the fact that the fibrous seed (cotton piece) must necessarily fall onto the surface of the adjacent drum when it is thrown off the surface of the drum pile.



1- Cotton moisture content 12 %, $m_ч^1 = (0{,}2 \div 0{,}25)m_ч$;

2- Cotton moisture content 10 %, $m_ч^1 = (0{,}12 \div 0{,}15)m_ч$;

3- Cotton moisture content 8,5%, $m_ч^1 = (0{,}05 \div 0{,}07)m_ч$;

4- Cotton moisture content 7,0%, $m_ч^1 = -(005 \div 0{,}08)m_ч$;

ΔS gap between the drums is taken to be close to zero. However, when the cotton is transported sequentially from above and below, it is important to take into account the trajectory of the distance S between the axes.

Figure 5 shows the movement trajectory of seeded cotton as a function of its moisture content. According to their analysis, when the moisture content of cotton is 12%, i.e., when the mass of fiber seed increases by 1.25 times its average value, according to the movement trajectory, it is next to the drum If it falls to point I , then at a moisture content of 10% , the trajectory of the cotton seed will fall to point II . Similarly, when the moisture content of the cotton decreases to 7% , the mass of the cotton seed will also decrease, and its trajectory will fall to point IV . In this variant, the cotton seed will almost never reach the surface of the adjacent drum and will fall to the surface of the mesh, its movement will be slow.

Therefore, even when the cotton moisture

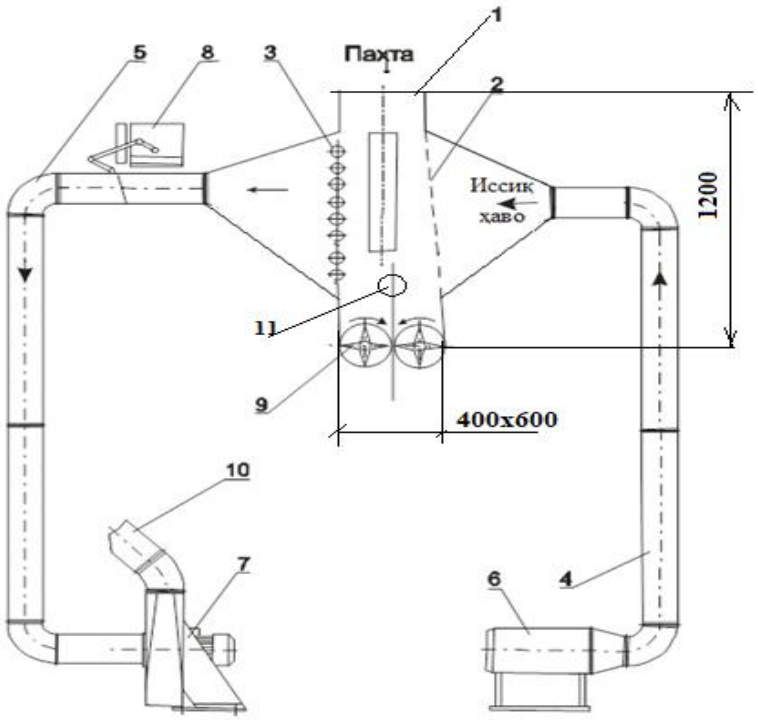
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content is (7.5÷8.0)% or more, the cotton seed is guaranteed to fall onto the surface of the adjacent drum.

In this case, the friction force of the fiber seed with the surface of the pile varies depending on the moisture content of the cotton. This depends on the value of the parameters in equation (3). If the ejection condition α_2 is met, the trajectory of the cotton seed will be significantly extended and reach the upper part of the adjacent drum surface (Figure 5, Graph 1). As the moisture content of the cotton decreases, α_1 the trajectory of the ejection of the fiber seed with the surface of the pile also decreases (Figure 5, Graph 1). Thus, a high moisture content of the fiber seed leads to an increase in its trajectory of movement. However , an increase in the moisture content of the cotton leads to a number of negative consequences, the friction of the cotton pieces decreases, their mixing with the waste decreases, the friction force increases, and the movement slows down. Therefore, the cotton moisture content
should be in the range of (8.0÷9.0)%, the mass of the cotton seed
$(0,05\div0,07)m_ц$ It is desirable to be in the range .

the mine with a supply-heating device , it was found that by uniformly distributing the cotton raw material along the mine and increasing the speed of hot air to 4.5 m/sec. and increasing the air temperature to 110-130 ^{0}C, we can increase the temperature of the cotton fiber to an acceptable level, but excessively increasing the air temperature and speed can affect the physical and mechanical properties of the cotton fiber and the movement of cotton in the mine. During the experiments, a supply-heating mine was prepared (Fig. 5) and installed in the equipment for cleaning from small impurities.



1- supply shaft,
2-type surface, 3-rollers,
4, 5 and 10 pipes,
6-cooler, 7-fan,
8-barrier, 9-supplier,
11-buffer drum.

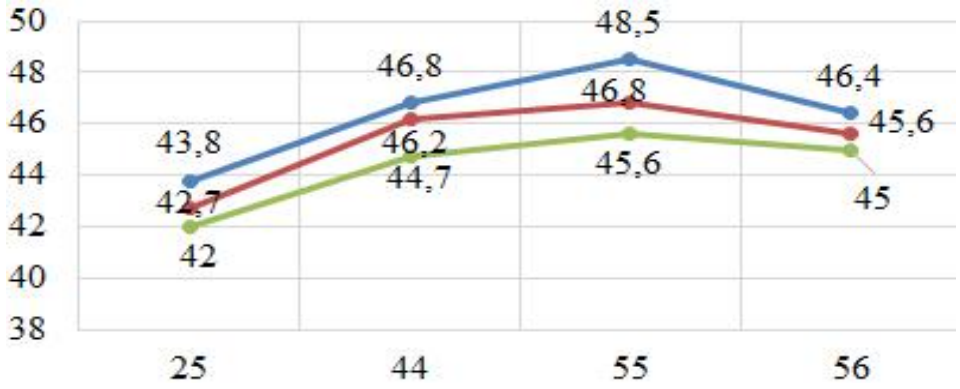
(Fig 6). The supply heater is a mine with a device

The initial moisture content of the cotton samples taken to study the effect of cotton fiber temperature on the cleaning efficiency of the equipment was 9.6% for industrial grade I cotton, and the degree of contamination was 8.5%. The results of the experiment are presented in Figure 6 below.

The following experiments showed that the cleaning efficiency decreases with increasing equipment efficiency, but we can see that the cleaning efficiency is highest at cotton fiber temperatures of 44; 55 ^{0}C, which corresponds to air temperatures from 90 to 120 ^{0}C.

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7 . Effect of cotton fiber temperature on cleaning performance.

To ensure that the cotton being transported passes through the shaft without jamming, the effect of changing the geometric dimensions of the shaft on the cleaning efficiency of the hot air temperature passing through the cotton in the shaft was studied.

were carried out without changing the dimensions of the lower part of the shaft, but setting the height of the air inlet into the shaft to 0.4 m, 0.6 m, and 0.8 m.

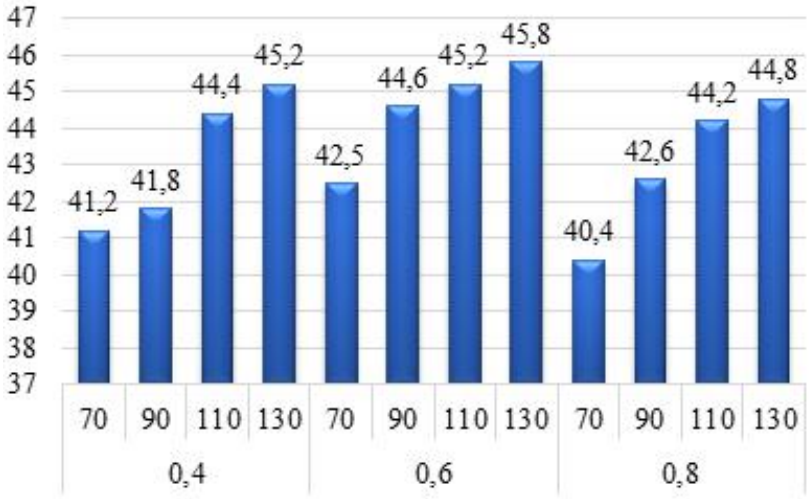
The experimental results in Figure 7 show that the highest indicator is when the mine height is 0.6 m and the air temperature is 70 ^{0} C, the cleaning efficiency is 42.5%, and at 130 ^{0}C, it is 45.8%. In this case, the air speed is set to 2.5 m/s per hour, and when the air speed is increased to 4.5 m/s, the highest indicator is when the mine height is 0.6 m and the air temperature is 70 ^{0} C, the cleaning efficiency is 44.6%, and at 130 ^{0}C, it is 48.8%. According to the results of the experiment, when the hole height is 0.6 m, the cleaning efficiency is high at an air temperature of 90-110 ^{0} C, since the surface area of the cotton processing area in the mine and the speed of the hot air passing through the cotton layer are relatively proportional.

The cotton being fed to the mine falls directly onto the supply shaft, causing the load pressure to increase, causing both shafts to operate in two different ways. The buffer drum installed above the supply shafts rotates freely around its axis in the mine, dividing the cotton flow coming from above into two directions and ensuring smooth operation of the feeders by holding the load above.

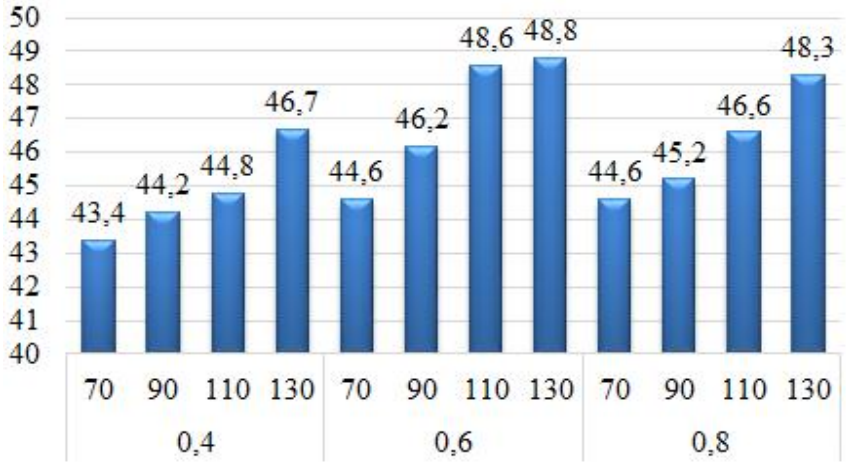
The cotton fed to the mine falls directly onto the supply shaft, and the increased load pressure causes both shafts to work in two ways. The buffer drum installed on the supply shafts rotates freely around its axis in the mine, allowing the cotton flow coming from above to fall in both directions and holding the load above, ensuring the smooth operation of the feeders and increasing the cleaning efficiency by increasing the duration of contact of hot air with the cotton. The effect of the installation height of the buffer drum in the mine relative to the supply shafts on ensuring the installed work efficiency of the equipment was studied.

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8. The effect of changes in the height of the hole for introducing heated air into the cotton shaft and the air temperature on the cleaning efficiency (air velocity 2.5 m/sec, work productivity 7000 kg/h).



(Fig 9). The effect of changes in the height of the heated air inlet hole and air temperature on the cleaning efficiency (air velocity 4.5 m/sec, work productivity 7000 kg/h).

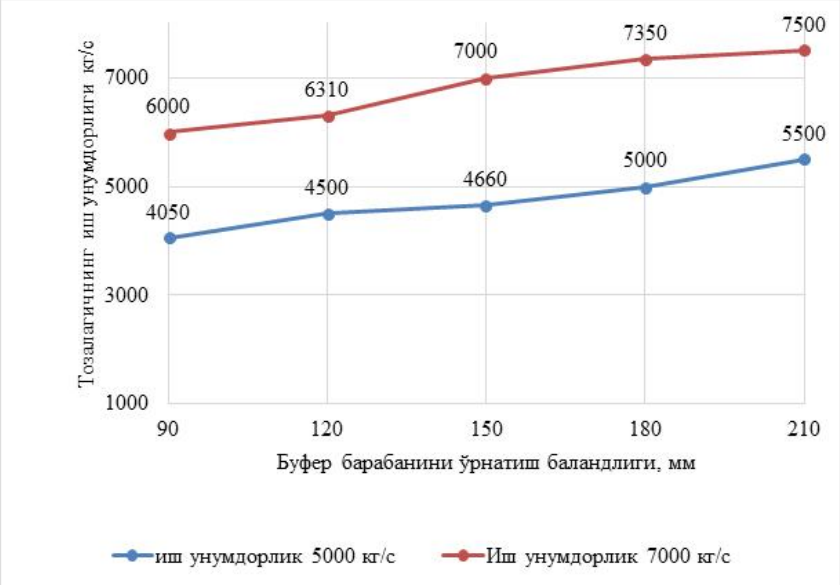
The experiments were carried out in a 1HK purifier under production conditions. In the experiments, the buffer drum was installed at a height of 90, 120, 150, 180 and 210 mm above the feeder (Fig. 9).

The graphs in Figure 9 below show the impact of the unit on its productivity, and it is clear that, assuming that the cotton is fed to the center of the feed rollers, it is advisable to set the buffer drum height, which is assumed to be 200 mm in diameter, to 150 mm for high-grade cotton and 180 mm for low-grade cotton.

Based on the results of the preliminary experiment, the main factors affecting the quality of the cotton gin were identified and multifactorial experiments were conducted. The experimental work was carried out on cotton of the Sultan selection, I-industrial variety, with an initial moisture content of 13.4% and an impurity content of 9.6%.

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(Fig 10). Effect of mounting height of buffer drum over feeder on performance

The cleaning efficiency U_1 and the increase in mechanical damage to the seed U_2 were taken as the criterion limits for assessing the quality of cotton separated from cleaning. The main factors affecting the established criteria were: X_1 - hot air temperature, ^0C, X_2 - height of the heating hole installed in the cotton shaft , m, X_3 - equipment productivity, t / hour . As a result of the preliminary processing of the experimental results using computer applications, the following regression equations were obtained, which sufficiently describe all output parameters according to the Fisher criterion:

On the cleaning efficiency of the equipment:

$$Y_1 = 42.572 + 4.850 X_1 + 0.630 X_2 - 1.160 X_3 - 3.194 X^2_1 - 1.229 X_1 X_2 + 0.321 X_1 X_3 - 1.627 X^2_2 + 0.162 X_2 X_3 . \quad (5)$$

On the increase of mechanical damage to the seed:

$$Y_2 = 0.825 + 0.207 X_2 + 0.157 X_3 + 0.165 X^2_1 + 0.054 X_1 X_2 \quad (6)$$

The resulting optimization problem was solved using the random search method and modern computer application programs, and the following optimal solutions were obtained: the heated air temperature was 120 ^{0} C, the height of the heat hole in the cotton shaft was 0.6 m, and the equipment productivity was 6 t/h.

At the value of the given factors, the effective operation of the cotton raw material cleaner from small impurities was observed, that is, the cleaning efficiency is higher than 45 %.

Conclusions

1. An analysis of the results of scientific studies on the effect of cotton temperature on cleaning efficiency revealed that we can achieve high efficiency at cotton temperatures of 45-50 ^0C.

2. Differential equations were derived to describe the eccentric motion of the buffer drum, which provides a smooth transmission of cotton for cleaning, taking into account the moment of inertia and the moment of friction forces in the bearings, based on the equilibrium condition .

3. Higher quality cotton seed leads to an increase in its trajectory. However , increasing the moisture content of cotton has a number of negative consequences, cotton particles are reduced, mixing with waste is reduced, the force of friction increases, and the movement slows down. Therefore, $(0,05 \div 0,07)m_q$ it is desirable for cotton moisture to be in the range of (8.0÷9.0)%, in the range of fiber seed mass.

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4. By taking into account the fact that a piece of cotton caught in a drum is thrown upward at a certain angle depending on its mass and the angular velocity of the drum, a numerical solution of the system was obtained, and the law of motion of the piece of cotton along the surface of the drum drum was obtained.

5. By uniformly distributing the cotton raw material along the supply shaft and increasing the speed of hot air to 4.5-6.5 m/sec and increasing the air temperature to 110-130 ^{0}C, we can increase the temperature of the cotton fiber to the required amount, but excessively increasing the air temperature and speed can affect the physical and mechanical properties of the cotton fiber and the movement of cotton in the shaft.

References:

1. Z.O‘.O‘tashov, A.K.Usmankulov, R.K.Jamolov, Sh.D.Dilshodov. Paxta xomashyosini mayda iflosliklardan tozalashning samaradorligini oshirish yo‘llari // «Zamonaviy tadqiqotlar, innovatsiyalar, texnika va texnologiyalarning dolzarb muammolari va rivojlanish tendensiyalari» ilmiy-texnik anjuman (2022-yil, Jizzax).
2. Ўташов З.Ў., Усманкулов А.К., Юсупова Ш.А., Анорбоева Х. Пахта хомашёсини майда ифлосликлардан тозалашнинг самарадорлигини ошириш йуллари // Ishlab chiqarishning texnik, muhandislik va texnologik muammolarining innovatsion yechimlarimavzusidagi xalqaro miqyosdagi ilmiy-texnik anjumani materiallari to‘plami, 1-Qism (2022 yil 28-29-oktabr), Jizzax.
3. A.K.Usmankulov, Z.O‘.O‘tashov, R.K.Jamolov.To develop an improved technology of cleaning cottonraw materials with high humidity //International scientific and practical conference cutting edge-science 2022 Shawnee, USA Conference Proceedings Primedia E-launch Shawnee, October 2022, -Pp.70-76.
4. А.Г.Севостянов Моделирование технологических процессов. М. Легкая и пищевая промышленност, 1984 , 344 с.
5. А.Ю.Ишлинский.Прикладные задачи механики. М. «Наука» 1986. 366 с.
6. Ergashev Yu, N. M.Oripov, Abduqaxorov A.A.. Separatorda qo‘llangan konussimon to‘rli sirtning mayda iflosliklardan tozalash jarayonini tahlili // Scientific-technical journal (STJ FerPI, FarPI ITJ, NTJ FerPI, 2022, T.26. спец. выпуск №16) 32-37 b. (05.00.00 №20).
7. Севостянов А.Г. Методы и средства исследование механико-технологических процессов текстилной промышленности. Москва» Легкая промышленност». 1980.г
8. N. M.Oripov, D.B. Tursunbayeva. Theoretical analysis of fibre cleaning equipment // Journal of Advanced Research and Stability Volume 04 Issue 04, Apr – 2024, p. 141-147.
9. ResearchBib)R.Muradov. Ways to improve the efficiency of the cotton separator. Namangan edition, 2005, pp. 62-63.
10. R.Muradov. Cotton Basics of an air carrier to increase the effectiveness of the device. Science. Tashkent, Navuz edition, 2014, pp. 15-16.
11. N. M.Oripov, Komilov.J., Xoliqova.Z., Toshmirzayev.Q.. Research on the introduction of a double-faced improved cotton separator // International journal of innovations in engineering research and technology [ijiert], India, Volume 7, Issue 12, Dec.-2020. p. 105-110. ((12) Index Copernicus)
12. Dilmurod Turgunov, Nodirbek Oripov, Bekzod Mominov, Dildora Khalilova. Analysis of the dynamic model of seed movement in the pneumotransport system // E3S Web of Conferences 538, EDP sciences, French, p. 03006 (2024). (Scopus)