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THEORETICAL STUDY OF THE EFFECT OF A BRUSHED DRUM SHAFT ON THE EFFICIENCY OF FLUSH SEPARATION

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Abstract: In this article, research was carried out to improve the brush drum-type Linter machine, which effectively cleans the fluffy product obtained by linting cotton seeds from impurities. In the study, a brush drum that effectively removes lint (fluff) from the saw teeth in a linting machine, a number of brushes located on the drum, and the length of the arc between the intersection and separation of the brushes with the saw teeth and The theoretical studies studied the intersection angles that form them. It was established that the wicker the drum effectively separates the saw teeth without negatively affecting the natural properties of the product.

Keywords: Linter machine, fluff, impurities, lint, brush drum, guide, mesh surface, beveled corner, supply roller, density valve, seed chamber, mixer, seed comb, coil grid, saw cylinder, lint discharge channel, die conveyor, air chamber.

Introduction. In connection with the entry of the Republic of Uzbekistan into the world market and the increasing need for the production of lint, scientists and the cotton ginning industry are faced with tasks related to the increase in product volume, quality and cost. This increases the economic importance of the production of products, which is an important factor not only in the development of industrial activity, but also in the improvement of the material and cultural standard of living and the well-being of the people. However, the ginning industry is currently not well equipped with modern equipment to ensure high productivity, high quality lint and seeds. Seed linting technology is one of the most labor-intensive and expensive stages of the cotton processing process. In linting, equipment and power consumption is up to 30%, and the production area is more than 40% of the cotton mill. In addition, the cost of buying lint is low compared to the production costs to obtain it, making lint production unprofitable. The introduction of new engineering and technical developments into production is of great importance in the development of industry and is the main factor of economic growth.

In the existing linter machine used in cotton cleaning enterprises, the short fibers cut from the cotton seed by the sharp teeth of the saw, the air flow coming out of the nozzle of the air chamber separates the lint (fluff) and short fibers from the saw teeth, the fluff is sucked into the pipe (lintootvod), and then transferred to the condenser. It is known from the researches that it is not possible to obtain a quality product by cleaning seed cotton, cotton pieces, fiber or lint (fluff) products transported by pneumatic transport from impurities during their movement in the air. Lint (fluff) is separated from the air and cleaned of fluff impurities in the OVM-A-1 fiber material cleaning device and sent to the pressing process. As a result of the study of the masking process, it was found that the VS-8 fan motor, which drives air at high pressure into the air chamber of the

linter machine, and the OVM-A-1 type lint cleaning devices, which are used to improve the quality of lint despite the low cleaning efficiency, have a negative effect on the economy of the enterprise.

The goals and objectives of the study. The cleaning device of the proposed new construction is installed on the existing linter machine at the enterprise and works without affecting the technological process. This is it research did not have a negative impact on the technological process as it conformed to the requirements of the President of the Republic of Uzbekistan in the new Development Strategy of Uzbekistan for 2022-2026, including the requirements for the rapid development of the national economy and ensuring high growth rates, reducing the consumption of electricity in the production of products and introducing technologies that produce high-quality competitive products. in this case, an improved lint cleaning device, which increases the working life of the linter machine, was created and put into production.

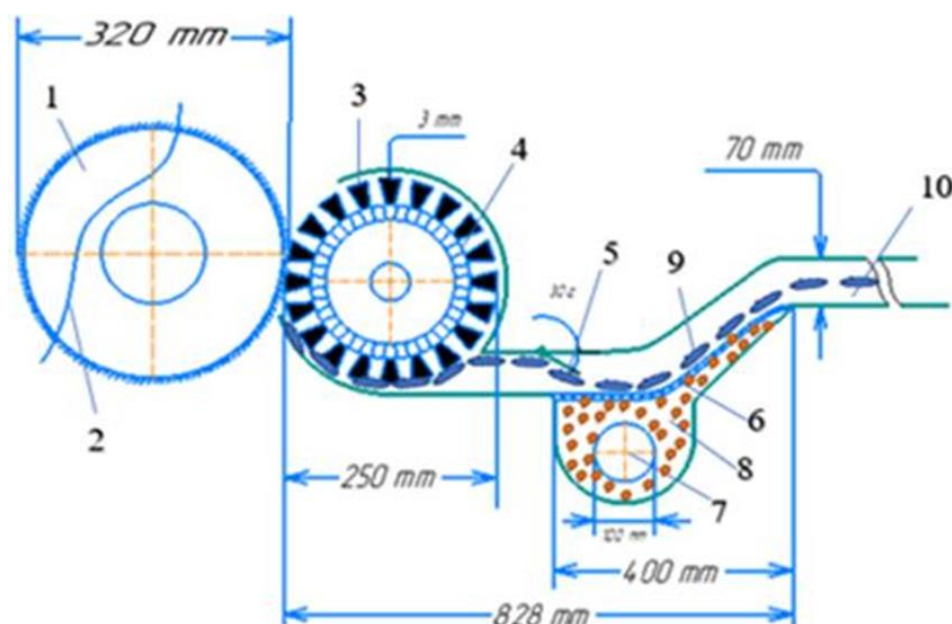


Figure 1. Lint separation of the brush drum from the saw tooth and its cleaning scheme

Tools involved in the main operation of the device: 1. Saw cylinder, 2. Colossal grid, 3. Body, 4. Brush drum, 5. Guide, 6. Mesh surface, 7. Dirt auger, 8. Dirt, 9. Lint (fluff), 10- Lint (fluff) discharge pipe to the condenser.

In recent years, brush drums that do not deform during cotton ginning have been developed with the help of many artificial nylon bristles. In this regard, the task of studying some aspects of this type of fluff removal arose. Information on the removal of fibrous materials using brush drums in literary sources does not allow optimal solution of design problems when creating new machines. There are also misconceptions about how brush drums work.

Results. According to the requirements for lint removal from the saw cylinder during the linting process, fibers of the drum brush should penetrate to the surface of the

saw cylinder, i.e. between the saw blades, to a depth of approximately 2-2.5 mm (Fig. 1). Consequently, the interaction between the brush drum and the saw cylinder occurs in a small area limited by points.

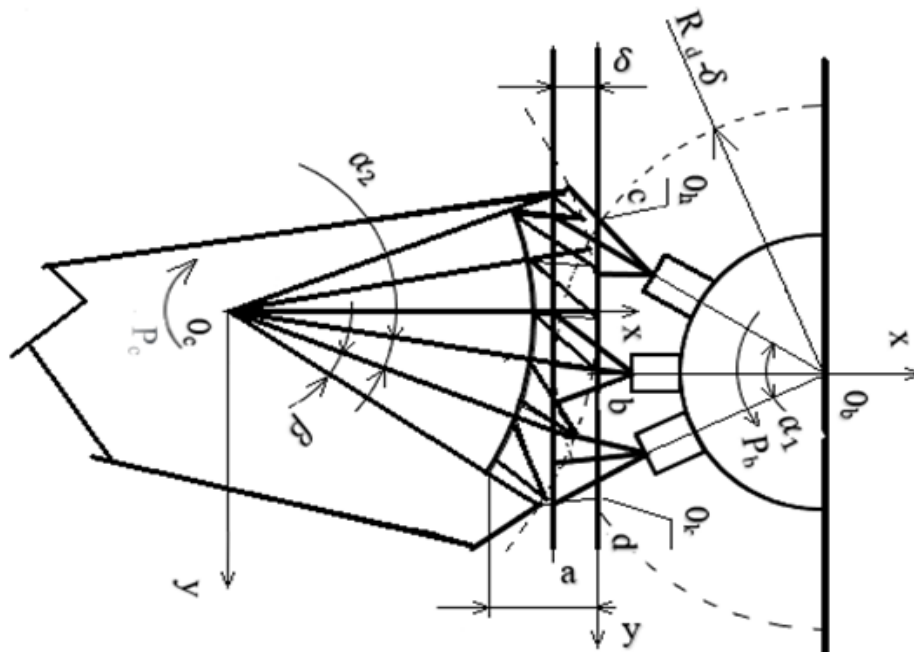


Figure 2. Scheme of interaction (period of contact) between the saw cylinder of the linter and the brush drum

According to Figure 2, we calculate the length of the arc using the following formula $\cup O_h O_{k'}$, let's find out:

$$\cup O_h O_k = R_6 \beta, (\text{rad}) \quad (1)$$

$\cup O_h O_k$ knowing the values, we can write:

$$\cos \frac{\beta}{2} = \frac{R_6 - \delta}{R_6}, \quad (2)$$

(2) solving equation 3 with respect to and $R_b = 250$ mm. (existing construction P_b) by calculating $\beta = 0.32$ rad let's find out. If we consider the values of β , we $\cup O_h O_k = R_6 \beta = 80$ mm we get.

Calculation of the turning angle of the saw cylinder. Diameter of existing saw drum structure $r_k = 320$ mm. Therefore, in order for the saw cylinder to completely rotate around its axis, its center must pass through an arc of the following length:

$$U l_{dr} = 2\pi r_k = 2 \cdot 3.14 \cdot 320 = 2009,6 \text{ mm}$$

Theoretically, in the interaction of the saw drum with the brush drum, the angle of rotation around its axis $\cup O_h O_k$ va $\cup l_{dr}$ can be determined by comparing the lengths of the arcs.

$$\varphi_{dr=r_k} = 3 \frac{u_{0h0k}}{u_{ldr}} \cdot 180^\circ = \frac{80}{2099,6} \cdot 180^\circ = 7.16^\circ$$

Calculation of the duration of exposure to the surface of the brush drum saw cylinder. Of the drum in existing cotton ginning equipment $P_b=1100$ ayl/min yoki 18,3

ayl/s knowing the rotations, we determine the path through the center of the saw drum in one second: $L = 2\pi R_d \cdot n_d = 2 \cdot 3.14 \cdot 250 \cdot 18,3 = 2873,1 \text{ mm}$

$$t_{air} = \frac{O_h O_k}{L}, \text{sek} = \frac{80}{2873} = 0,027$$

Calculation of the angle of rotation of the brush drum when the saw cylinder interacts with the brush drums. According to the data, the rotation angle of the brush drum can be calculated using the following formula: $\theta = 2\pi \cdot P_c \cdot t_{air}/\text{sek}$

(3)

Here, P_c is the number of revolutions of the brush drum $P_c = 1100 \text{ ayl/min} = 18,3 \text{ ayl/sek}$;

$$\theta = 2 \cdot 3.14 \cdot 1100 \cdot 0,027 = 186,7^\circ.$$

If we consider that the number of brush plates in a brush drum is 20, then there are 10-11 plates at an angle of 186° , and accordingly, the number of strokes will also be within these limits.

In that case, it is possible to determine the rotation of the saw cylinder at an angle

m μ_j :

$$\mu_j \cdot \frac{2\pi/z}{h^*}, (\text{rad/mm}) \quad (4)$$

According to the formula, we determine the length of the working arc of the circular saw cylinder with a single brush.

$$S^* = \mu_j AC^* r_{dr} \quad (5)$$

Undoubtedly, in order to remove a piece of cotton from the surface of the saw cylinder with brushes, the rotation speed of the saw cylinder V_2 should be greater than V_1 . Fiber-removable strips interact in the saw section. When the saw cylinder turns at an angle of 2α , the brush drum must turn at an angle not less than $2\alpha_2 + \beta$.

If τ_1 va τ_2 , represent the angle of rotation of the saw cylinder and the brush drum, respectively, the removal of a piece of cotton from the saw cylinder can be expressed as follows:

$$\begin{aligned} \tau_1 &> \tau_2, \\ \tau_1 &= \tau_2, \\ \tau_1 &= \frac{2\alpha_1}{\omega_1}, \quad \tau_2 = \frac{2\alpha_2 + \beta}{\omega_2}, \end{aligned} \quad (6)$$

Here ω_1, ω_2 are angular speeds of the saw cylinder and brush drums, respectively rad/s; α_1, α_2 va β -angles, rad.

τ_1, τ_2 after substituting values into expression (6), the calculation formula takes the following form.

$$n_2 = n_1 \frac{K(2\alpha_2 + \beta)}{\alpha_1} \text{ ayl/min}, \quad (7)$$

Here K is the safety factor ($K = 1,15-1,25$);

α - the central angle between two removable lines.

2- it follows from the picture:

$$\alpha_1 = \arctg \frac{x_1}{(r_1 + r_2) - y_x} \text{ rad}, \quad (8)$$

$$\alpha_2 = \arctg \frac{x_2}{(r_1 + r_2) - y_d} \text{ rad}, \quad (9)$$

The coordinates of point D are determined from the intersection of circles I and II:

$$y_1 = \frac{r_2^2 + (r_1 - r_2)^2}{2(r_1 + r_2^2)}, \quad (10)$$

$$x_1 = \sqrt{r_2^2 - r_d^2}, \quad (11)$$

In that case, the equation takes the following form:

$$n_2 = n_1 \frac{K(\alpha_1 + \beta)}{\alpha_1}; \quad (12)$$

The angles α_1 va α_2 are determined by formulas (8) and (9) and the coordinates of point d are in accordance with the same formulas as in points (10) and (11).

Research shows that the available air flow in the area of fiber removal from the saw cylinder helps to remove the lint, that is, the removal of cotton from the saw cylinder continues mechanically and the air flow factor is limited to the cotton transport function.

The obtained results make it possible to objectively assess the effectiveness of the interaction of the saw cylinder with a brush drum during operation and to optimize the parameters of the lint removal zone from the saw cylinder.

Conclusion. The given equations make it possible to determine the angular speed of rotation of the drum, which is selected for machines of various purposes. For example, cylinders and drums with a diameter of 320 and 500 mm have an arc interval of 80 mm ($\approx 17^\circ$), the optimal required speed for linting is calculated.

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C O N T E N T S

TECHNICAL SCIENCES: COTTON, TEXTILE AND LIGHT INDUSTRY

Rakhimov R., Sultonov M.	3
Inspection of the strength of the column lattice of the improved fiber cleaner	
Turdiyev B., Rosulov R.	10
The influence of technological parameters of the elevator on cotton seed damage	
Khuramova Kh.	15
Graphic analysis of the obtained results on cotton regeneration	
Sharifbayev R.	20
Optimizing feature extraction in Ai-based cocoon classification: a hybrid approach for enhanced silk quality	
Akramov A., Khodzhiev M.	24
The current state and challenges of the global textile industry: key directions for the development of Uzbekistan's textile sector	

TECHNICAL SCIENCES: AGRICULTURE AND FOOD TECHNOLOGIES

Sattarov K., Jankurazov A., Tukhtamyshova G.	30
Study of food additives on bread quality	
Madaminova Z., Khamdamov A., Xudayberdiyev A.	37
Determination of amygdalin content in peach oil obtained by pressing method	
Kobilov N., Dodayev K.	43
Food safety and industrial importance of corn starch. the impact of the hydration process on the starch content in the grain	
Mustafaev O., Ravshanov S., Dzhakhangirova G., Kanoatov X.	50
The effect of storing wheat grain in open warehouses on the "aging" process of bread products	
Erkayeva N., Ahmedov A.	58
Industrial trials of the refining technology for long-term stored sunflower oil	
Boynazarova Y., Farmonov J.	64
Microscopic investigations on the effect of temperature on onion seed cell degradation	
Rasulova M., Xamdamov A.	79
Theoretical analysis of distillators used in the distillation of vegetable oil miscella	

CHEMICAL SCIENCES

Ergashev O., Bazarbaev M., Juraeva Z., Bakhronov H., Kokharov M., Mamadaliyev U.	84
Isotherm of ammonia adsorption on zeolite CaA (MSS-622)	
Ergashev O., Bakhronov H., Sobirjonova S., Kokharov M., Mamadaliyev U.	93
Differential heat of ammonia adsorption and adsorption mechanism in Ca ₄ Na ₄ A zeolite	
Boymirzaev A., Erniyazova I.	101
Recent advances in the synthesis and characterisation of methylated chitosan derivatives	
Kalbaev A., Mamataliyev N., Abdikamalova A., Ochilov A., Masharipova M.	106
Adsorption and kinetics of methylene blue on modified laponite	
Ibragimov T., Tolipov F., Talipova X.	114
Studies of adsorption, kinetics and thermodynamics of heavy metall ions on clay adsorbents	
Muratova M.	123
Method for producing a fire retardant agent with nitric acid solutions of various concentrations	
Shavkatova D.	132
Preparation of sulphur concrete using modified sulphur and melamine	
Umarov Sh., Ismailov R.	139
Analysis of hydroxybenzene-methanal oligomers using ¹ H nmr spectroscopy methods	
Vokkosov Z.	148
Studying the role and mechanism of microorganisms in the production of microbiological fertilizers	
Mukhammadjonov M., Rakhmatkarieva F., Oydinov M.	153
The physical-chemical analysis of KA zeolite obtained from local kaolin	
Shermatov A., Sherkuziev D.	160
Study of the decomposition process of local phosphorites using industrial waste sulfuric acid	
Khudayberdiev N., Ergashev O.	168
Study of the main characteristics of polystyrene and phenol-formaldehyde resin waste	

TECHNICAL SCIENCES: MECHANICS AND MECHANICAL ENGINEERING

Kudratov Sh.	
UZTE16M locomotive oil system and requirements for diesel locomotive reliability and operating conditions	174
Dadakhonov N.	181
Device studying the wear process of different materials	
Dadakhonov N., Karimov R.	189
Investigation of irregularity of yarn produced in an improved drawn tool	
Mirzaumidov A., Azizov J., Siddiqov A.	196
Static analysis of the spindle shaft with a split cylinder	
Mirjalolzoda B., Umarov A., Akbaraliyev A., Abduvakhidov M.	203
Static calculation of the saw blade of the saw gin	
Obidov A., Mirzaumidov A., Abdurasulov A.	208
A study of critical speed of linter shaft rotation and resonance phenomenon	
Khakimov B., Abdurakhmanov O.	217
Monitoring the effectiveness of the quality management system in manufacturing enterprises	
Bayboboev N., Muminov A.	232
Analysis of the indicators of the average speed of units for the process of loading into a potato harvesting machine	
Kayumov U., Kakhkharov O., Pardaeva Sh.	237
Analysis of factors influencing the increased consumption of diesel fuel by belaz dump trucks in a quarry	
Abdurahmonov J.	244
Theoretical study of the effect of a brushed drum shaft on the efficiency of flush separation	
Ishnazarov O., Otabayev B., Kurvonboyev B.	250
Modern methods of smooth starting of asynchronous motors: their technologies and industrial applications	
Kadirov K., Toxtashev A.	263
The influence of the cost of electricity production on the formation of tariffs	
Azambayev M.	271
An innovative approach to cleaning cotton linters	
Abdullayev R.	277
Theoretical substantiation of the pneumomechanics of the Czech gin for the separation of fiber from seeds	
Siddikov I., A'zamov S.	282
Study of power balance of small power asynchronous motor	

Obidov A., Mirzaakhmedova D., Ibrohimov I.	288
Theoretical research of a heavy pollutant cleaning device	
Xudayberdiyeva D., Obidov A.	294
Reactive power compensation and energy waste reduction during start-up of the electric motor of uxk cotton cleaning device	
Jumaniyazov K., Sarbarov X.	302
Analysis of the movement of cotton seeds under the influence of a screw conveyor	
Abdusalomova N., Muradov R.	310
Analysis of the device design for discharging heavy mixtures from the sedimentation chamber	
Ikromov M., Shomurodov S., Boborajabov B., Mamayev Sh., Nigmatova D.	318
Study of obtaining an organomineral modifier from local raw materials to improve the operational properties of bitumen	
Ikromov M., Shomurodov S., Boborajabov B., Mamayev Sh., Nigmatova D.	324
Development of composition and production technology for polymer-bitumen mixtures for automobile roads	
Muradov R., Mirzaakbarov A.	332
Effective ways to separate fibers suitable for spinning from waste material	

ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

Xoliddinov I., Begmatova M.	336
A method of load balancing based on fuzzy logic in low-voltage networks with solar panel integration	
Murodov R., Kuchqarov A., Boynazarov B., Uzbekov M.	345
Research on the efficiency of using hydro turbines in pumping mode and for electricity generation	
Abdurakhimova M., Romanov J., Masharipov Sh.	353
A literature review of settlement land trends (past, present, and future) based on english-language articles indexed in the web of science database from 2014 to 2023	
Muhammedova M.	360
Development and scientific justification of the design of orthopedical footwear for patients with injuries to the soul-foot joint	
Akbaraliyev M., Egamberdiyev A.	367
Methods of effective organization of fire and rescue operations	

A'zamxonov O., Egamberdiyev A.

Principles of organizing material and technical support in emergency situations **373**

Tuychibayeva G., Kukibayeva M.

The module of developing communicative competence of seventh and eighth-grade students in uzbekistan secondary schools **379**

Ismoilova Z.

Methods for enhancing the competence of future english teachers **383**

ECONOMICAL SCIENCES

Yuldashev K., Makhamadaliev B.

The role of small business entities in the program "From poverty to well-being" **389**

Mirzakhlikov B.

Organizational mechanism for the development of state programs for poverty reduction **397**

Rustamova S.

Specific characteristics of administration in developed countries **402**
