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Research Article

INCREASING THE EFFICIENCY OF THE PROCESS OF SEPARATING LINTERS FROM COTTON SEEDS

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ABSTRACT

Analysis of the studies conducted by domestic and foreign academic researchers to improve the lint separation process shows that the existing lint separation machines have high energy consumption and low process efficiency. The main reason for these shortcomings is the high coefficient of friction of the working surfaces of the lint separation machines that come into contact with the raw materials, and the rapid corrosion of the working surfaces is the cause of these problems. Especially in the autumn and spring months with high air humidity, the working surfaces are quickly corroded, causing a sharp increase in the coefficient of friction between the surface and the seed mass. This study focuses on the effect of the coefficient of friction on the parameters of the lint separation process and its reduction.

KEYWORDS

Process, lint, performance, air, friction, surface, improvement, machine, corrosion.

INTRODUCTION

In our republic, special attention is paid to increasing the production of high-value-added finished products based on deep processing of cotton raw materials, improving the structure of the country's cotton ginning industry, reducing the cost of cotton products and improving their

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quality indicators based on technical and technological restructuring. The new Uzbekistan Development Strategy for 2022-2026 sets out tasks, including "...to ensure the rapid development of the national economy and high growth rates and to double the production volume of textile industry products." In implementing these tasks, it is important to improve the working chamber of the linting machine based on theoretical and practical analysis of the process of separating cotton lint from the seeds and thereby increase the efficiency of the linting process, including by improving the adhesion of cotton lint to the saw teeth and coordinating the speed of the raw material.

It is necessary to study the lint separation process more thoroughly and use other methods to accelerate the exit of the lint-separated seed from the working chamber. In the research conducted to date, the issue of accelerating the exit of the lint-separated seed from the working chamber of the lint separation machine by improving the design of the grate has not been sufficiently studied.

The aim of the research is to improve the efficiency of the lint separation process by developing a new, corrosion and erosion resistant, low friction co-efficient grate design for lint separation.

A number of studies were conducted on the proposed grate, improving the working elements of the linting machine. The purpose of the studies is to create a plane on the working surface of the grate-type linting machine so that the separated seeds can exit the grate-type chamber in a timely manner, and to prepare a device that performs this process, determine its effective technological dimensions, and introduce it into production.

METHODS

The differential equations of the movement of seeds on a grate with a profile of three broken straight lines were integrated using piecewise functions in the Maple 9.5 program under initial conditions, and the laws of motion and changes in speed over time, the laws of movement and changes in speed of seeds on a grate with a broken linear profile at different angles, and the laws of change of friction coefficients were studied. An increase in the friction coefficient leads to a decrease in the movement and speed of the seeds over time.

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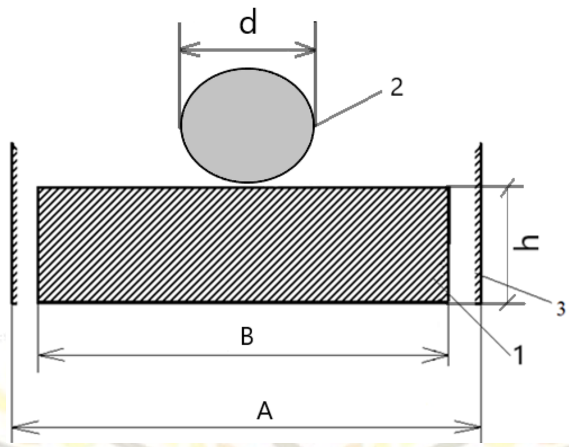


1- a grate, 2- a seed separated from lint, 3- a saw.
A- distance between saws, mm; B- grate width, mm; h -grate thickness, mm; and d- seed diameter, mm.
Figure 1. Seed location on the surface of the grate

Below (Figure 1), the laws of motion of separated seeds on the surface of the grate are theoretically studied.

Regardless of the degree of coarseness, the forces exerted by the working surface of the grate on the separated seeds between the saws are considered from the point of view of statics.

Mathematical model of the problem.

a) The separated seeds (Fig. 2) move along the arcuate section AB of grate from top to bottom under the influence of their own weight G=mg. We consider the seed to be a material point with a mass m, and examine its motion: AB is the section, relative to the natural coordinate system.

Let us assume that the separated seed moves along an arc AB with radius R and center at point O.

The equation of motion of the seed along the surface of the grate is as follows:

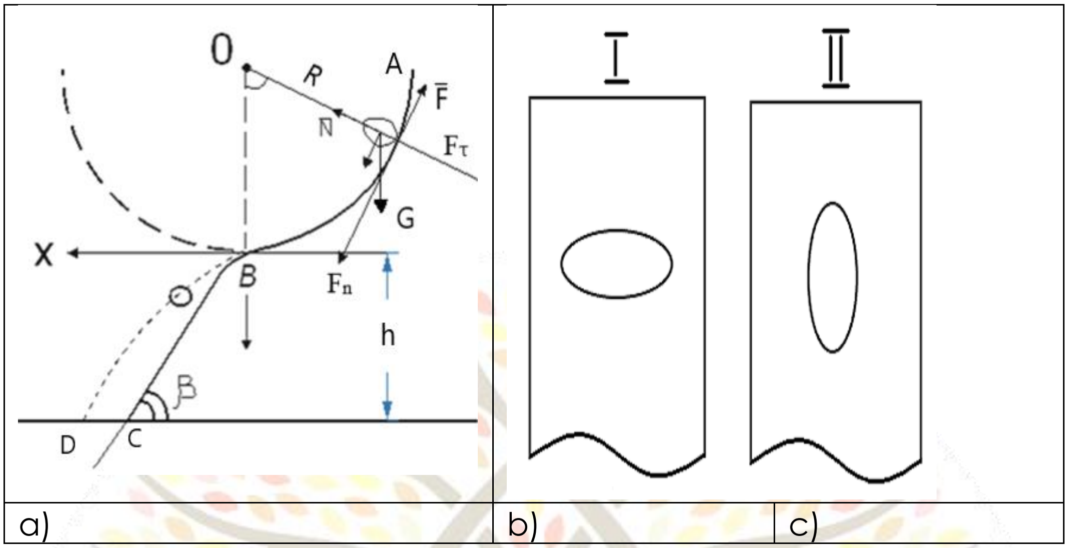
$$\begin{cases} m\frac{dv}{dt} = F_r \\ m\frac{v^2}{R} = F_n \end{cases} \qquad (1)$$

where R – radius of curvature of the grate;

ν– seed speed;

m – mass, kg;

Taking into account all the forces acting on the seed, the differential equation of motion of the seed along the arc AB is obtained:



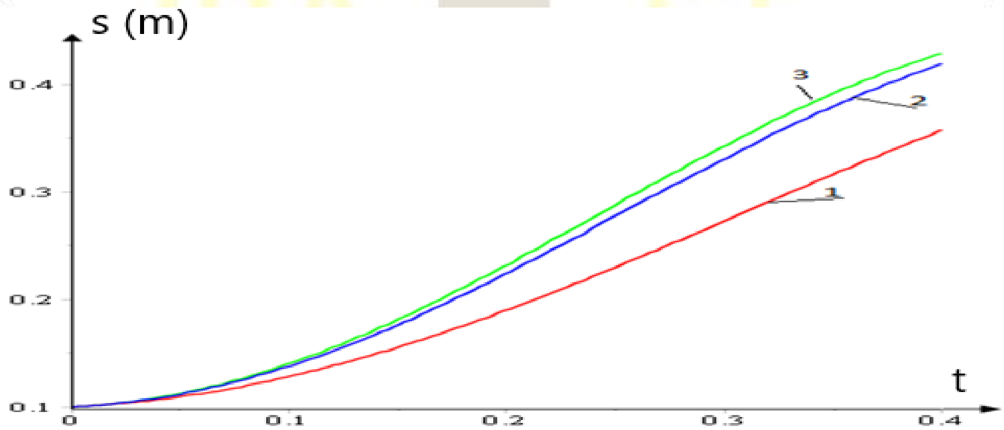
a) seed movement to change related power scheme, (b and c) seed condition
Figure 2. The movement of a seed separated from the wool

$$S''(t) = \frac{g}{K}(\cos\frac{S(t)}{R} - f \cdot \sin\frac{S(t)}{R} \qquad (2)$$

This differential equation is solved numerically using the MAPLE-9.5 program.

$$t=0 \; S(0)=0 \qquad V(0)=S(0)=0 \qquad (3)$$

The initial conditions were obtained from the results of computer analysis with the following values of the parameters: seed mass 0.14 – 0.18 grams (1.4 – 1.8x10 $^{-3}$ kg), friction coefficient f=0.6; 2-f=0.5; 3-f=0.4, grate curvature radius R = 0.9 – 0.105 m (90 – 105 mm), grate length s = 0.6 m, and rotation angle φ= 0 - 2 π.



1- f =0.6 ; 2- f =0.5 ; 3- f =0.4
Figure 3. Time variation of the path traveled by seeds along the grates at different friction coefficients

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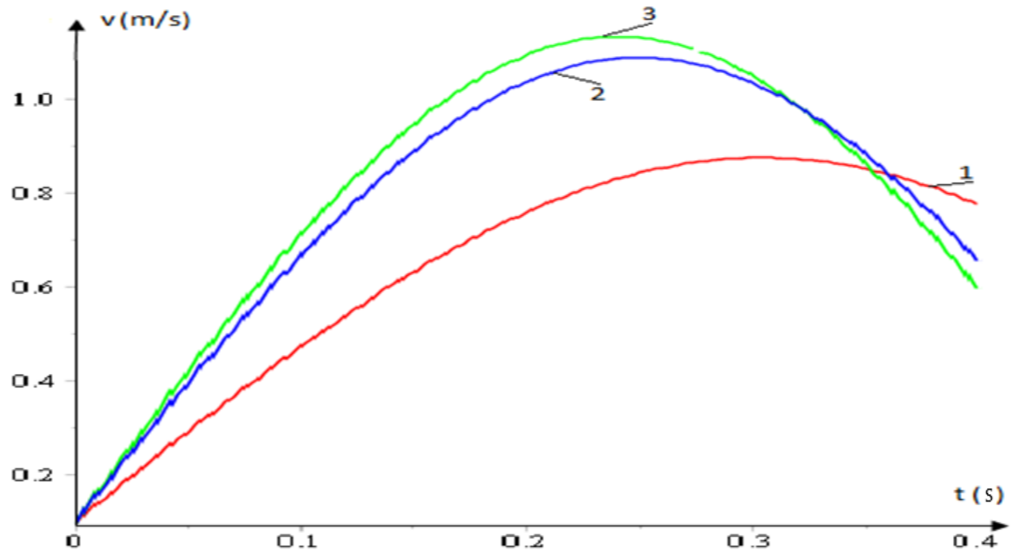


1-f=0.6; 2-f=0.5; 3-f=0.4

Figure 4. Time variation of the rate of seed falling along the grates at different friction coefficients

Using the corresponding law of motion, the dependence of the path traveled by the seeds along the grates to which the seeds are fixed, the rate of fall over time, and the speed of the seeds on the surface of the grates on the path traveled are presented in the graphs in Figures 3-5 for three different materials with different friction coefficients for the working surface of the seeds.

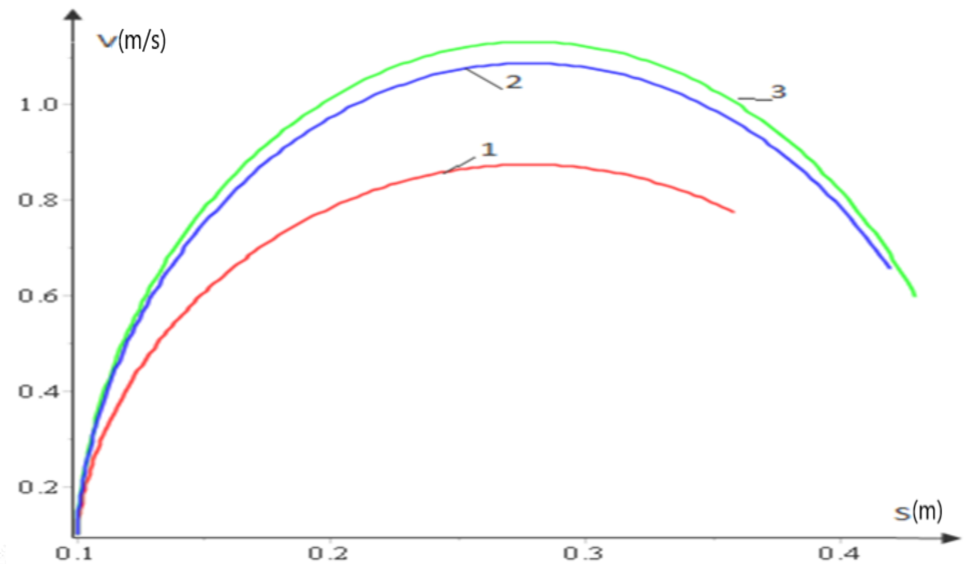
b) We check the movement of the seed and along the BC section of the grate.

The time taken by the grain to travel the arc AB from point B of the grate is τ. It moves in the x y plane with a velocity VB(τ).

Here , the law of motion of the seed with respect to the xy coordinate system is as follows:

$$\begin{cases} mx'' = 0 \\ my'' = G = mg \end{cases} \qquad (4)$$

As a result of the analysis of the equation in the Maple program, the trajectory of the seed's movement in the BC section was obtained (Figure 5).



1-f=0.7; 2-f=0.5; 3-f=0.4

Figure 5. Variation of the speed of movement of seeds along the grate at different friction coefficients depending on the distance traveled

The analysis of the grain velocities revealed an uneven distribution of velocities along the contour, with the highest value decreasing in the flat part of the velocity, and the velocity increasing in the final straight part.

Based on the above studies, an alternative contour of the grate was selected and the laws of motion of the grains transmitted using them were studied.

The roughness of the working surface of the grate, the friction coefficient, and the wear indicators of the grate were experimentally studied in laboratory conditions, and taking these factors into account, the material was selected, and a grate structure made of a new material was developed.

The main goal of conducting experimental research is to eliminate the shortcomings of the current grate and to create a new grate with a smooth working surface, i.e., a low coefficient of friction, wear resistance during the lint separation process, non-sparking during the reaction process, high corrosion resistance, ease of preparation technology and a positive effect on the efficiency of lint separation, i.e., to improve the lint separation process. Therefore, if a material containing an alloy of non-ferrous metals is taken for the working surface, the above positive factors can be achieved. In addition, the method of comparing materials is to identify their positive and negative aspects and prepare a new design with optimal properties.

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The selection of a material with high smoothness for the working surface of a grate and its use for a new structure is an important task of scientific research. The roughness of the materials taken for the sample was studied experimentally. The materials used for the sample were cast iron of the Сч15-32 grade, steel of the В2Ф grade, and stainless steel of the 32НК-ВИ grade. The experimental work was carried out on the "Time 3200" device. This device is capable of testing materials up to 10 mm long. The surface roughness value was measured using a specially installed sensor.

It is possible to see different heights of roughness on this device, that is, the roughness of an area of 10 mm long can be determined at different values Table 1).

Table 1. Roughness of the working surface of the grates made of different materials

№	Roughness to be determined	Сч15-32 grade cast iron material	В2Ф grade material	32НК-ВИ grade material
1	R_a , microns	0.796	0.312	0.180
2	R_q , microns	1,070	0.429	0.282
3	R_z , microns	4,996	2,255	2,128
4	R_t , microns	9,100	4,340	4,519
5	R_p , microns	2,276	0.680	0.515
6	R_v , microns	2,720	1,679	1,611

The process of studying the friction coefficient of materials was carried out in the laboratory of the Andijan Machine-building Institute on a T25 model device designed to determine the friction coefficient. As a result, the values f=0.75 and 0.78 were obtained for the cast iron grate material, the values f=0.57 and 0.62 for the В2Ф grade steel grate material, and the values f=0.46 and 0.48 for the 32НК-ВИ grade stainless steel material. From this it can be concluded that it is expedient to select and use the 32НК-ВИ grade stainless steel material as the material with the lowest friction coefficient for the working surface of the new composition grate structure.

Conclusion

The analysis of the results of the studies considered on the topic led to the following conclusions:

1. The analysis of the studies conducted by domestic and foreign scientific researchers to improve the operation of lint separators and their main elements made it possible to identify a number of shortcomings of existing saw lint separators and determine research directions for their elimination.

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2. The differential equation obtained as a result of a theoretical study of the movement of the seed separated from the lint on the surface of the lint separator grate made it possible to determine the trajectory of seed movement.

3. In the process of scientific research, the friction coefficient showed the values f=0.75 and 0.78 for the Сч15-32 cast-iron grate, the values f=0.57 and 0.62 for the В2Ф steel material, and the values f=0.46 and 0.48 for the 32НК-ВИ stainless steel material. From this it can be concluded that it is appropriate to select and use 32НК-ВИ stainless steel as the material with the lowest friction coefficient for the working surface of the new grate.

REFERENCES

1. Ergashev Sh.T., Sarimsakov O.Sh., Shokirov X.T., Sharifjanov A.O. (2023). O‘zbekiston Respublikasi Adliya vazirligining foydali modelga patenti № FAP 02331. Arrali tola ajratgich uchun kolosnik. Rasmiy axborotnoma.
2. Sarimsakov O.Sh., Shokirov X., Shamsiddinov E. (2023). Jin mashinasining samaradorligini oshirishga bag‘ishlangan ilmiy-tadqiqot tahlillari. Mashinasozlik ilmiy-texnika jurnali, Andijon, pp. 299-306.
3. Shokirov X.T. (2024). Tayyorlangan tarkibli kolosniklarning paxtani jinlash jarayoniga ta’sirini tahlili. Qurilish va ta’lim ilmiy jurnali, Namangan, №1 pp. 100-104.
4. Sarimsakov O.Sh., Ergashev Sh.T., Shokirov X.T. (2024). Yangi tarkibli kolosnik konstruksiyasining natijalari tahlili. Mexanika va texnologiya ilmiy jurnali, Namangan, Maxsus son, № 1(8). pp.190-198.
5. Sarimsakov O.Sh., Ergashev Sh.T., Shokirov X.T. (2024). Arrali tola ajratgich uchun tarkibli kolosnik konstruksiyasining sinov natijalar tahlili. Ilmiy-texnika jurnali, Farg‘ona, № 2. pp. 86-91.
6. Tursunovich, M. E., Ugli, U. A. A., & Esonaliyevich, R. S. (2024). Analysis of the effect mechanism and chemical composition of cooling lubricants in mechanical processing. Web of Technology: Multidimensional Research Journal, 2(11), 151-158.
7. Юлчиева, С. Б., Негматов, С. С., Негматова, К. С., Мамуров, Э. Т., Мадаминов, Б. М., & Рубидинов, Ш. Г. У. (2021). Повышение коррозионностойкости композиционных материалов с добавлением полимерных добавок. Universum: технические науки, (10-1 (91)), 48-52.
8. Eldor, M. (2022). Control of metal cutting process based on vibroacoustic signal. Universum: технические науки, (6-6 (99)), 63-67.