WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 5, May., 2022

DETERMINATION OF THE OPTIMAL PARAMETERS OF THE COTTON CLEANING DEVICE BASED ON A COMPUTATIONAL EXPERIMENT

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Annotation

Due to the fact that Uzbekistan has chosen a digital economy in its development strategy, it is necessary to modernize agriculture, digitalization, and develop technologies based on the production of high-quality fiber at cotton spinning mills. In addition, a radical new approach to the operation of ginneries, the use of modern information technologies to eliminate contaminants in cotton through mathematical modeling and software to determine the optimal parameters of ginning equipment to improve fiber quality. This article describes a mathematical model for determining the parameters necessary for the normal operation of the considered cotton gin, on the basis of which a computational experiment was carried out and the values of the parameters were determined. The article developed a mathematical model of the movement of a piece of cotton on the surface of a vibrating mesh (separator), taking into account the factors affecting the process of cleaning cotton from small impurities and its application. Experimental studies were carried out on the basis of the developed program and methodology for determining the normal values of parameters that affect the efficient operation of the cotton gin device. Finally, by calculating the parameters of the device using the compiled programs and the computational experiment, results are obtained in which the lighting operations are displayed graphically in an appropriate way.

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Keywords: Separator, experimental studies, movements of a piece of cotton in a separator, computer simulation, computational experimentation, harmonic movement of a piece of cotton, optimal parameters of cotton ginning equipment, mathematical model of the technological process of cleaning cotton.

I. Introduction

Uzbekistan keeps pace with world development, steps on the threshold of the third Renaissance. It is expected that the choice of the digital economy in its development strategy will lead to drastic changes and shifts in the field of information technology and in general in other areas, which will lead to significant changes in the economy of the republic. Because, the implementation of such work of global importance will significantly improve the standard of living of the population [1,2].

Naturally, the human factor plays a special role in the development of society. There is a creative nature in his work, and a person is constantly in search. Day after day, he conducts research on the results of his work, develops an effective product. However, this product is developed by different people in different ways, and its effectiveness may vary.

In this sense, a person often observes events that exist and need to be studied to further improve a product or development that is really needed, and collect scientific experiments or try to find an effective research method. Based on them, he conducts experiments and receives results. The prepared article has tried to shed light on this very question. В ходе нашего исследования были изучены работы исследователей по процессу очистки хлопка и их оцифровке [3-9].

Our research work is aimed at determining the parameters of the cotton cleaning device, which will serve to increase its effectiveness. In our study, this work was first carried out in more complex stages after a simple case:

- at the initial stage of the study, the issue was approached taking into account the simplest particular cases of the cotton cleaning process [10-14]. In this case, the study is carried out with the simplest movement of a piece of cotton over the surface of the grid (sieve or separator) (Fig. 1);
- at the second stage of the study, approach the problem taking into account the parameters of the cleaning device in the cleaning process. In this case, we conducted a study of the complex movement of a piece of cotton in the device (separator), both the proposed surface and its mesh surface [15-18];
- At the third stage of the study, we approached the problem by conducting a computational experiment based on a mathematical model of the cleaning process in a cotton gin. At the same time, experiments were carried out on the basis of a model

of the complex movement of a piece of cotton in the separator of the device, and the results were obtained [19-22].

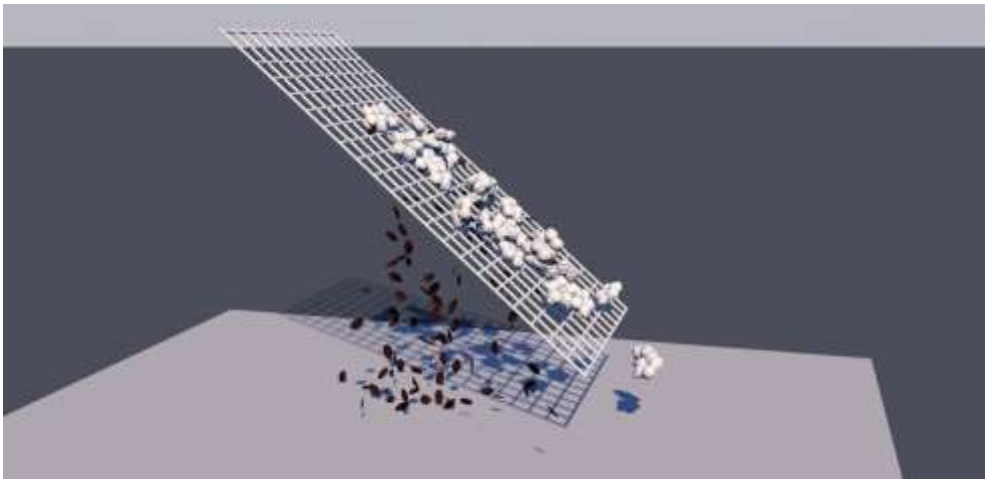

Fig 1. Separator for cleaning raw cotton.

II. Materials and Methods Section

Although it is often possible to conduct a practical experiment to obtain results, it is economically expensive and this situation can lead to unacceptable solutions. In this case, the object under study is replaced by a "computer model" and its behavior is checked for various external influences.

The reliability of computer models of the object under study (separator technology of cleaning cotton) and its formation allows you to check the parameters of the technological system and the effect on them of changes in the initial conditions (for example: the angle of inclination of the separator relative to the horizon, the coefficient of friction and how other parameters can affect the cleaning process).

Computer modeling requires a qualitative selection of the features of events, primarily a qualitative representation. This is done by performing a sequence of computational experiments on the computer, interpreting the results, comparing the simulation results with the behavior of the compared object, and other steps.

Computational experimentation is, in fact, a computerized process of conducting an experiment on a mathematical model of the object under study. Such a model is much cheaper and more convenient than a conventional experiment (initial model), with the help of which the test passes faster and takes less time, provides detailed information about the parameters that characterize the state of the system.

The development of a mathematical model of an object is a sequence of iterations, first of all, based on the available information about the system under study, a model is built, a sequence of computational experiments is carried out, and the results are analyzed. In the event of the appearance of new information about the object being

checked, additional factors are taken into account, the behavior of the process on the computer is studied.

In this sense, in the separation technology of cleaning cotton, it is advisable to study not only the linear movement of a piece of cotton (Fig. 1), but also to study its harmonic movement, since such an approach determines the quality of the technology. Therefore, we are studying the movement of a piece of mechanically vibrating cotton on the surface of the grid.

When forming a mathematical expression, according to a mechanical law, the process of harmonic oscillation of a piece of cotton on the surface of the grid is taken as a basis, and for a particular case we present it in the following diagram (Fig. 2).

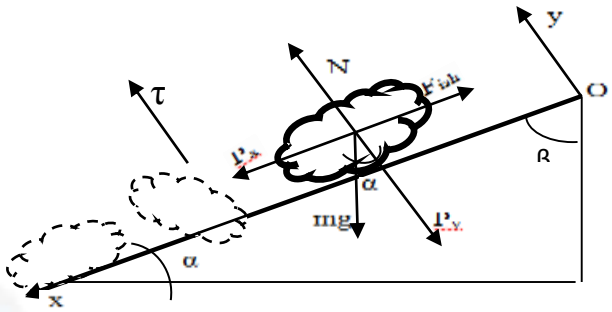

Figure 2. Harmonic movement of a piece of cotton on a mesh surface (separator) and the forces acting on it.

Consider a piece of cotton that is in relative motion in the oy direction according to the expression of the harmonic law (1) (Fig. 2).

$$\tau = A\sin\omega t \qquad (1)$$

In this case, the forces acting on the cotton fiber ox and oy in the direction ($X = ma_x$, $Y = ma_y$) have the following expression:

$$\left.\begin{aligned} X &= P\sin\alpha - F_{ish\_x} \\ Y &= N - P\cos\alpha = A\sin\omega t \end{aligned}\right\} \qquad (2)$$

Here:

$P = mg$ - gravity; m is the mass; g is the free fall acceleration.

$F_{ish\_x} = \mu_x N$ - the force of friction acting on a piece of cotton. μ_x - coefficient of friction; N — normal compressive strength. A – amplitude of oscillations under the action of an external force. ω- Number of oscillations, Hz.

Based on the above expressions, the differential equation of motion of a piece of cotton can be written as (3):

$$\left.\begin{aligned} ma_x &= mg\sin\alpha - \mu_x N \quad (a) \\ ma_y &= N - mg\cos\alpha \quad (б) \end{aligned}\right\} \qquad (3)$$

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ISSN: 2776-0979, Volume 3, Issue 5, May., 2022

Here a_x, a_y — acceleration of a piece of cotton along the X and Y axes. (3) Performing mathematical operations on both sides of the expression and making a number of changes, we determine the displacement expressions for the x and y coordinates, respectively:

$$\left.\begin{aligned} x &= (g\sin\alpha - \mu_x g\cos\alpha)\frac{t^2}{2} - \mu_x A\sin\omega t \quad (a) \\ y &= A\sin\omega t \quad (б) \end{aligned}\right\} \qquad (4)$$

In the system of equations (4), we write equation (a) in the form $x=x_1(t)+x_2(t)$, then:

$$x_1(t) = (g\sin\alpha - \mu_x g\cos\alpha)\frac{t^2}{2} \qquad (5)$$

$$x_2(t) = -\mu_x A\sin\omega t \qquad (6)$$

We can use several programming languages and tools to build software based on the mathematical model algorithms developed above. In the question we are considering, the exact solution of the harmonic motion of a piece of cotton on a vibrating mesh surface is unknown. Therefore, we cannot take this solution as a table and compare it with a specific solution. Having solved the problem in a given form (4) using the methods of solving a system of simple differential equations and Runge-Kutta, we can solve the problem by looking at its graph (depending on the normal state of the oscillation graph).

III. Experimental Results

Based on the algorithms constructed above, we conduct experiments using the MatLab software package. In this case, using the program based on equation (5), we obtain the results in the form of a graph giving the values of the coefficient of friction of the mesh surface μ (mu) and the angle of inclination (alpha) (Figure 3):

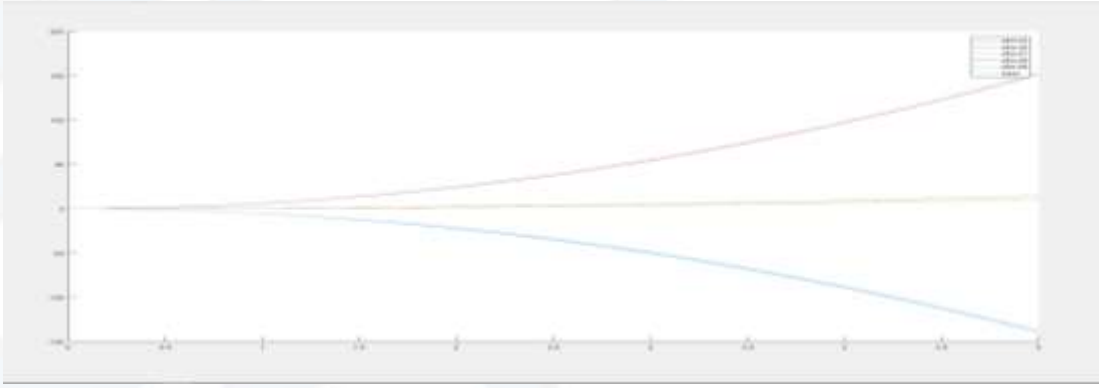

Figure 3. Graph of the change in the speed of movement of a piece of cotton in a mesh surface along the X axis.

From the results obtained (Fig. 3) it can be seen that the movement is observed uniformly in cases where the coefficient of friction of the mesh surface μ = 1 and tilt

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angle α = 26, α = 29 degrees. Therefore, further research will be carried out on these values..

Using equation (a) of the system of equations (4) and the values determined above, we obtain graphical results of the movement change by assigning amplitude (A) and frequency values (ω) oscillations of the grid surface. From the result obtained (Fig. 4) it can be seen that at the angle of inclination α = 26 degrees, the oscillation amplitude A = 20, the frequency ω = [5-8] Hz movement of a piece of cotton is uniform. During such a movement, the effectiveness of cleaning operations is observed..

In the above order, we get the results for the case when the angle of inclination α = 29° C degrees (Fig. 4):

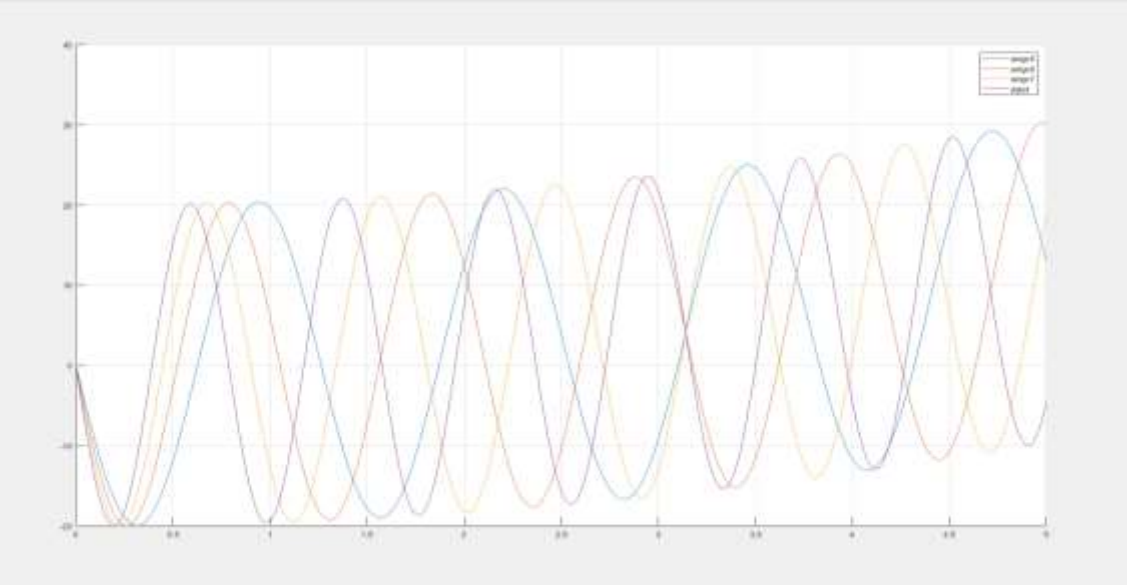

Figure 4. Graph of the change in the speed of the complex movement of a piece of cotton in a mesh surface.

From the result obtained (Fig. 4) it can be seen that at the angle of inclination α = 29° from degrees, oscillation amplitude A = 20, frequency ω = [5-8] Hz the movement of a piece of cotton is uniform.

IV. The Discussion of the Results

As a result of the research, it was found that the movement is uniform with a friction coefficient μ = 1, tilt angle α=[26°-29°] with an amplitude of 20 mm and a frequency of oscillations of 8 Hz.

Today's reforms and changes by the state have led to a radical new approach to the operation of ginneries, the elimination of contaminants in cotton through mathematical modeling and software to determine the optimal parameters of ginning equipment to improve fiber quality.

Based on the above algorithms, the following experiments were carried out using the MatLab software package and the results were obtained. The main parameters of the cotton cleaning separator are: oscillation amplitude A; oscillation frequency ω; μ - coefficient of friction. According to these parameters, a study of a piece of cotton moving in a separator was carried out, that is, the speed of movement (movement) of cotton was observed: slow, moderate, fast. It is known that high speed does not allow to completely clean the cotton. Conversely, slow movement of the cotton may result in a reduction in cleaning efficiency in the separator or a stop in the movement of the cotton. Based on the experiment, it can be said that the angle of inclination of the cotton for a uniform speed $\alpha=[26^{o}–29^{o}]$ degrees; The optimal values were obtained by taking the coefficient of friction $\mu = 1$ at the amplitude A = 20 mm and the number of vibrations w = 8 Hz. The use of such optimal indicators when creating a cotton gin will bring great benefits in the future.

References

1. Постановление Президента Республики Узбекистан от 28 апреля 2020 года № ПП-4699 «О мерах по внедрению цифровой экономики и электронного правительства».
2. Указ Президента Республики Узбекистан № ПФ-6079 от 5 октября 2020 года (Национальная база законодательства, 10.06.2020, 20.06.6079/1349; 04.02.2021, 21.06.6198/0269).
3. Атауллаев А.Х., Равшанов Н. Исследования процесса сепарирования сыпучих семян хлопчатника и рушанки.- Москва. – 1989г. С.–Деп. в вниити.,1989. N2035.
4. Равшанов Н., Компьютерное моделирование технологических процессов сепарирования смесей./ Н.Равшанов – Ташкент «Adabiyot uchqunlari», 2014.-308С.
5. Theoretical and Experimental Studies of the effect of incluned Scraper on RAW Cotton from mech Surface. World Journal of Mechanics, USA.2014,4, 371-377.http//dx.,doi.org/10.236/wjm.2014.412036. Published Online Desember 2014 in Scires. http://www.scrip.org/journal/wjm.
6. Погорелова А.С. Разработка математической модели сепарирования трудно разделяемых сыпучих смесей с учетом силы воздушного потока/журнал, Фундаментальные исследования. – 2015. – № 2 (часть 17) – С. 3718-3722.
7. Ахмедходжаев Х.Т. , Умаров А.А. Технология и оборудование отрасли/учебное пособие. Наманган-2015.

8. Мурадов Р., Усовершенствование конструкции оборудования улавливания тяжелых примесей в составе хлопка. –Академия наук Республики Узбекистан издательства “Фан”, Ташкент -2007г. С. 5-9.
9. Тадаева Е.В., Хамракулов А.К., Бегматов Д.К. «Разработка новой конструкции и технологии сетчатого вращающегося четырёхбарабанного очистителя хлопка сырца от мелкого сора» Научно-технический журнал ФерПИ, № 4, 2016 год. С.156-159.
10. Хашимов С., Холмирзаев И., Отабаев Б. Математическая модель тела, движущегося в наклонной плоскости, и ее программное обеспечение. Республиканская научно-практическая конференция «Роль инновационных образовательных технологий в повышении качества образования: проблемы и решения» Наманган. 29-30 марта 2019 г. Страницы 302-304.
11. Хашимов С., Дадамирзаев М., Тургунов М., Отабоев Б. Вопросы разработки технологии очистки хлопка и проектирования эффективных устройств с использованием воздушного потока. Республиканская научно-практическая конференция «Повышение эффективности промышленных предприятий за счет диверсификации инвестиций». Наманган, 2019г. 7-8 июня, стр. 296-298.
12. Хашимов С., Эркинов Х. Разработка математической модели процесса очистки хлопка от мелких примесей. XV Научно-практическая конференция профессоров, преподавателей и студентов на тему «Развитие информационно-коммуникационных технологий и программного обеспечения», Самаркандский филиал Ташкентского университета информационных технологий имени Мухаммада ал-Хоразмий, 5 марта 2020 г., часть 2.
13. Хашимов С., Эркинов. Х., И.Махамаджанов. Математическое моделирование некоторых вопросов 30-31 марта 2021 г. в Наманганском инженерно-строительном институте Республиканская научно-практическая конференция на тему «Роль информационных систем и технологий в современном обществе». Страницы 143-146.
14. Хашимов. С., Эргашева. С, Собиров. Ш. Использование системы Autocad при конструктивном проектировании хлопкоочистительного завода. 30-31 марта 2021 года в Наманганском инженерно-строительном институте состоится республиканская научно-практическая конференция на тему «Роль информационных систем и технологий в современном обществе».
15. Равшанов. Н, Хашимов. С. Проблемы разработки технологического процесса очистки хлопка от мелкодисперсных частиц и пыли и их решение.

ISSN 2181-8622 Научно-технический журнал НамМТИ, www.nammti.uz Scientific and technical journal of NamIET, том 4 - Специальный выпуск №3 , 2019.

16. Равшанов. Н, Хашимов. С. Разработка математической модели процесса очистки хлопка от мелких примесей. Научный вестник НамГУ - Научный вестник НамГУ №12, 2020, декабрь.
17. Xashimov, S., Abdullayeva, N., Dadamirzayev, M., & Rizamuhamedova, G. Introduction of a cotton cleaning device for technical and technological re-equipment, modernization the cotton cleaning industry in Uzbekistan. SOI: 1.1/TAS DOI: 10.15863/TAS International Scientific Journal Theoretical & Applied Science p-ISSN: 2308-4944 (print) e-ISSN: 2409-0085 (online) Year: 2019 Issue: 05 Volume: 73 Published: 30.05.2019 http://T-Science.org Philadelphia, USA.. ISJ Theoretical & Applied Science, 05 (73), 536-540. Soi: http://s-o-i.org/1.1/TAS-05-73-82 Doi: https://dx.doi.org/10.15863/TAS
18. Sabitxan Xashimov, Xusniddin Erkinov Creating a mathematical model of movement in the process of cleaning cotton from dirt ISSN (Online): 2455-7838 SJIF Impact Factor : 6.260 Research &Development Volume: 5, Issue:2, February 2020 EPRA International Journal of (IJRD) Monthly Peer Reviewed & Indexed International Online Journal ISI I.F. Value : 1.241
19. Sabitkhan Hashimov, Irisqulov Farxod Sultonboyevich, Imamnazarov Erkin Dexkanaliyevich, Erkinov Husniddin Bakhtiyoro'g'li, Abdujalilov Sodiqjon Muhammadamino'g'li Problems of Development and Solution of Technological Processes ofCleaning Cotton with Small Dispersion Particles and Dust/ Palarch's Journal Of ArchaeologyOfEgypt/Egyptology 17(7),ISSN 1567-214x.
20. Ravshanov Normaxmad Kayumovich, Sabitxan Xashimov, Erkinov Husniddin Bakhtiyor oglu, Nuritdinov Nurbek Davlatalievich, G'ofurjonov Muhammadyusuf Conducting Experiments on the Process of Cleaning Cotton Design Engineering ISSN: 0011-9342 | Year 2021 Issue: 8 | Pages: 11095 – 11103.