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MUNDARIJA • СОДЕРЖАНИЕ • CONTENTS

Ma'lumot uchun, OAK Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

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MUNDARIJA

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THEORETICAL BASIS FOR ENSURING A COTTON LAYER ON A CONVEYOR BELT

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Abstract: In particular, to produce high-quality fiber, special attention is paid to ensuring optimal heat and moisture conditions for cotton raw materials during the cleaning and ginning processes, drying at high temperatures and reducing the use of traditional sources of hydrocarbons. In this direction, various methods of preparing and storing cotton, control and measuring methods and instruments, equipment, their formation, means of breaking cotton bunches and transporting cotton, drying cotton, and also reducing fuel consumption in the process of drying cotton raw materials per unit are used manufactured products are considered urgent tasks. The introduction of a textile cluster in order to implement economic reforms for the export of finished textile products to the world market through deep processing of cotton raw materials has posed unprecedented challenges for cotton ginning enterprises.

Keywords: cotton, tape, drying, infrared radiation, layer, efficiency, height, conveyor, movement.

Annotatsiya: Xususan, sifatli tola ishlab chiqarish uchun paxta xomashyosini tozalash va tozalash jarayonlarida optimal issiqlik va namlik sharoitlarini ta'minlash, yuqori haroratlarda quritish va uglevodorodlarning an'anaviy manbalaridan foydalanishni kamaytirishga alohida e'tibor qaratilmoqda. Bu yo'nalishda paxtani tayyorlash va saqlashning turli usullari, nazorat-o'lchov usullari va asboblari, asbob-uskunalari, ularni shakllantirish, g'o'za tuplarini sindirish va tashish vositalari, paxtani quritish, shuningdek, paxta xomashyosini quritish jarayonida ishlab chiqarilgan mahsulot birligiga sarflanadigan yoqilg'i sarfini kamaytirish dolzarb vazifalardan hisoblanadi. Paxta xomashyosini chuqur qayta ishlash orqali tayyor to'qimachilik mahsulotlarini jahon bozoriga eksport qilish bo'yicha iqtisodiy islohotlarni amalga oshirish maqsadida to'qimachilik klasterini joriy etish paxta tozalash korxonalari oldiga misli ko'rilmagan vazifalarni qo'ydi.

Kalit so'zlar: paxta, lenta, quritish, infraqizil nurlanish, qatlam, samaradorlik, balandlik, konveyer, harakat.

Аннотация: В частности, для получения высококачественного волокна особое внимание уделяется обеспечению оптимального тепловлажностного режима хлопкового сырья в процессах очистки и джинирования, сушке при высоких температурах и сокращению использования традиционных источников углеводородов. В этом направлении применяются различные методы подготовки и хранения хлопка, контрольно-измерительные методы и приборы, оборудование, их формовка, способы разбивки хлопковых пучков и транспортировки хлопка, сушка хлопка, а также снижение расхода топлива при сушке хлопкового сырья на единицу выпускаемой продукции. Создание текстильного кластера в целях реализации экономических реформ для экспорта готовой текстильной продукции на мировой рынок за счет глубокой переработки хлопкового сырья поставило перед хлопкоочистительными предприятиями беспрецедентные задачи.

Ключевые слова: хлопок, лента, сушка, инфракрасное излучение, слой, эффективность, высота, конвейер, движение.

INTRODUCTION

The efficiency of drying cotton with IR rays during its movement on the conveyor belt depends on the exposure time t of the rays and the height of the cotton layer on the belt h. The longer the exposure time t is, the higher the drying efficiency, and the lower the drying efficiency. The height h of the cotton layer on the tape has a negative effect on the drying efficiency, that is, if the height is high, the efficiency is low, and vice versa, it is high. Therefore, it is important to control the exposure time t and the height h of the cotton layer on the tape in the new drying method.

In the proposed equipment, the time of cotton in the dryer can be controlled by the speed of the belt. That is, if the speed is greater, the cotton stays in the dryer for less time, and if it is the opposite, it will be longer. This can be done by controlling the conveyor belt drive through an inverter. However, it is required to provide the required height of the cotton layer mechanically.

Research conducted in cotton gins shows that it is difficult to maintain a precise standard in the transfer of cotton to process machines, because cotton is not transferred to production manually or mechanically at the

same rate. Also, when cotton is stored in bales, its density increases to 350 g/m3 , and when the bale is broken and transferred to cotton production, it is in the form of large and small balls, and the density of this mass is high. This situation further increases the unevenness of cotton transfer.

We will consider the possibilities of ensuring the necessary height of the cotton layer. To solve this problem constructively:

- it is necessary to ensure that the cotton does not slip on the tape. This can be solved by installing slats on the conveyor belt.

- to tighten the cotton to the maximum and to install a device, i.e., a fixer, which ensures a layer of cotton of the required height on the tape. This event can be done by installing a piled drum at a certain distance on the conveyor belt. The drum squeezes the cotton and provides the required height of the cotton layer.

LITERATURE REVIEW ON THE TOPIC

The article by R.Djamolov[1] is devoted to the uniformity of the movement of a layer of cotton along a roller conveyor. The author develops an algebraic expression that determines the gaps in the accumulation of cotton on the conveyor surface. This theoretical approach allows us to identify problems related to the uneven location of the layer and its movement (for example, displacement, spreading during turning). Such a mathematical analysis is an important basis for the engineering theory of layer stability.

M. Barbursky[2] studies three stages of conveyor belt production – raw fabric, latex-coated fabric, and vulcanized belt. Although synthetics (polyester/nylon) are used instead of cotton, the elasticity and tensile strength of the layer vary depending on factors such as the mechanical properties of the core, the type of weave, and the density of the layer. Theoretically, this is important in choosing the type of layer and determining the durability of the conveyor.

L. Ładysławicz and M. Konieczna[3] propose an approach using the two-dimensional Kelvin–Voigt model to determine the rolling resistance of a conveyor belt. By analyzing the deformation and stress distribution of the layer in the time dimension, they add a previously unconsidered element - the particulate solution. From this, it is possible to better theoretically estimate the energy efficiency and resistance of the layer materials (for example, cotton layer).

In the study by M. Kolb and colleagues[4], the theoretical leading model studies the process of random arrangement of cotton fibers on a surface. The model is expressed as a diffusion process and exhibits “geometric ergodicity” — the system approaches a stable, memoryless state over time, forming a free fibrous layer (cotton layer). Theoretical philosophical position: the formation of the layer is based on statistical stability.

D. Turgunov[5] proposes a mathematical model for controlling and leveling the height of a cotton layer on a belt conveyor. The main problem is the variation in the height of the layer due to cotton pieces of different sizes. He theoretically explains how to reduce this uncertainty by using vibrating plates or a counter-rotating plate-and-paddle drum. This scientific analysis links the stable delivery of the cotton layer to the theoretical basis.

RESEARCH METHODOLOGY

In carrying out this research work, methods widely used in scientific research methodology were used. In the process of scientific analysis, these scientific research methods were widely used, in particular, observation, generalization, grouping, comparison, and in analysis, synthesis and analysis methods were widely used.

ANALYSIS AND RESULTS

Cotton raw material is a colloidal pore-capillary material with different types of moisture binding, and certain conditions should be taken into account when developing drying techniques and technologies, including:

- ensuring heat exchange;
- increase the production capacity of the device;
-maintain fiber and seed quality indicators;
- uniform removal of moisture from raw cotton components;
- avoid mechanical damage to the fiber.

Sample preparation. The scheme of a technical solution that can perform these tasks is presented in Figure

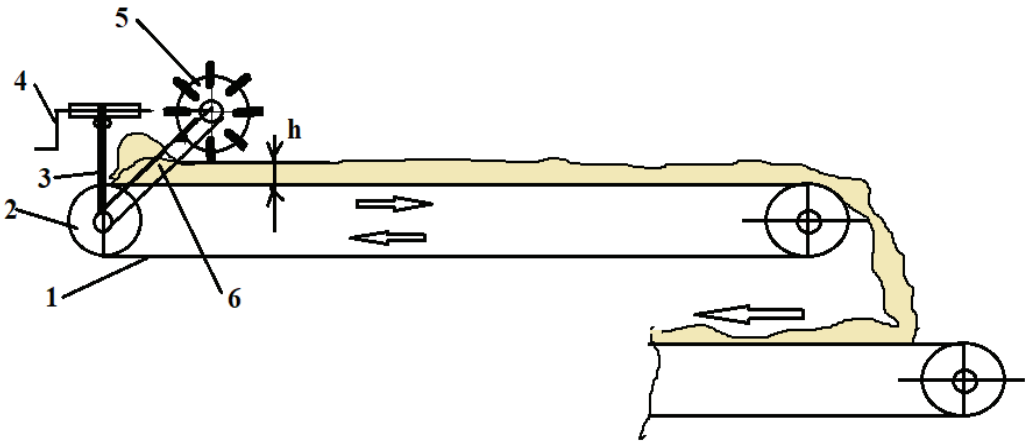

Figure 1. A device that ensures the required height of the cotton layer.

The device that ensures the required height of the cotton layer works as follows: the cotton moving on the tape 1, which is pulled on the roller 2, is pushed by the piled drum 5 and passes to the required height h. to ensure the height h, the screw adjuster 4 is fixed to the column 3 by means of a hinge, and the drum 5 is movably mounted on the main shaft 6.

To change the height h, the lever of the screw adjuster 4 is turned, so that the drum 5 is raised (or lowered) together with the main shaft 6. As a result, the distance between the tape and the pile drum increases (or decreases) [6-8]. When the height h increases, the dryer performance increases, but the drying efficiency decreases. When h decreases, the productivity decreases and the drying efficiency increases. It is also possible to control the dryer performance and drying efficiency by keeping the height h constant and increasing or decreasing the belt speed.

Now, let's analyze the process theoretically.

The cotton is moving without friction and the total amount of cotton entering and leaving the device is:

$$Q_{êèð} = Q_{÷èê} \quad (1)$$

Pile drum n smoothness flatten the cotton pad and tighten it. Part of the cotton lint is returned, and the rest goes to the drying zone in the drum zone. In this case, the cotton layer is divided into 2: trans missive and reversible layers. Let's consider [9-12] the process of relative movement of cotton layers. We assume that the leveling body is located along the vertical x-axis.

The two pieces of cotton move in opposite directions with respect to the x-axis. Let the total height of the layer be h.

We assume that the movement of the layers is based on the law of linear coupling with respect to the x-axis. Let the speed of the upper layer be U yu and that of the lower layer be Uo.

In order to apply the drying of cotton raw materials under the influence of infrared radiation based on functional ceramics in production conditions, it is necessary to create a production sample of the drying equipment that can meet the requirements of the technological regulation of the cotton ginning enterprise based on the results obtained in the laboratory stand.

According to the experiments carried out in laboratory conditions, it is necessary to organize the drying of cotton raw materials in a layer under the influence of infrared radiation based on functional ceramics, it is necessary to develop a suitable dryer for layer drying.

We write the equation of the relative displacement of the cotton layers at the leveling point [13-14]:

$$\mu \frac{\partial^2 ó}{\partial õ^2} = \gamma \frac{\partial^2 ó}{\partial t^2} \quad (2)$$

is zero:

$$\mu \frac{\partial^2 ó}{\partial õ^2} = 0 \quad (3)$$

(3) twice, we find the linear displacement q :

$$y = C_1 x + C_2 \quad (4)$$

integration constants C1 and C2 from the initial conditions:

$x = 0$ if $x = C_2 + U_p t$ there is and, $x = h$ if there is $y = -U_o t$.

In that case

$-U_p t = U_0 t + C_1 h$ $-U_o t = U_o t + C_1 h - U_o t = U_o t + C_1 h$,

from this

$$C_1 = -(U_p + U_0)t \cdot \frac{1}{h} \quad C_1 = -(U_o + U_o)t \cdot \frac{1}{h} C_1 = -(U_o + U_o)t \cdot \frac{1}{h} \tag{5}$$

Putting the findings, we determine the following equation of displacement:

$$y = \frac{(U_o + U_p)x}{h} t + U_p t \tag{5}$$

The equation of the relative velocity of Q particles can be derived by differentiating:

$$U = \frac{dy}{dt} = -\frac{(U_o + U_p)x}{h} + V_2 \tag{6}$$

The obtained results show that the transfer ability q of the leveler depends on the speed h of the tape, and the return ability q depends on the linear speed of the leveling body [19-20].

Speeds of the operating modes of the provider based on the required values of transmission. The performance of the belt device depends on the width of the belt, its coefficient of use of the unit surface, the linear speed of the belt, and the moisture and density of the layer of material moving on it.

The supplier we are designing is located at the beginning of the technological chain of primary processing of cotton, and its performance determines the performance of the entire technological chain. Therefore, it is important to calculate the performance of the new supplier. Based on the above, the supplier's cotton transfer efficiency equation can be expressed as follows [21]: The height of the passing cotton layer depends on the distance between the outer circumference of the leveling drum and the tape. This interval as h = 150 мм, we can find [17] the required belt speed or, if we take the belt speed, for example, 0.2 m/s, we can find the required layer thickness.

However, the force of contact between the q anots installed on the surface of the tape and the drum plates with the cotton pad q is reduced by the ratio h.

Now, we will analyze the performance of the dryer based on the belt conveyor throughput during the changeover period. The results are presented in table 1.

Looking at the results, it can be seen that both factors have a linear effect on dryer performance. In particular, as the belt speed increases, the dryer performance increases. In this case, as the value of the height of the cotton layer increases, the productivity increases with greater intensity. The results are presented graphically in Figures 2 (Table 1).

Table 1: Effect of belt speed and layer height on productivity

№	vл	h	y
1	0.1 0.2	0.1/0.2/0.3/0.4 0.2/0.4 0.3	0.153/0.306/0.459/0.612 0.200/0.400/0.500/0.700 0.450/0.550
2	0.5 0.6	0.1/0.2/0.3/0.4 0.3/0.4 0.35	0.765/1.53/2.295/3.06 0.800/2.58/3.100/3.56 2.78/3.150
3	1.0 1.5	0.1/0.2/0.3/0.4 0.1/0.2 0.15	1.53/3.06/4.59/6.12 2.03/3.16/4.71/6.78 3.26/4.89
4	1.5 2.0	0.1/0.2/0.3/0.4 0.2/0.3 0.25	2.295/4.59/6.88/9.18 2.312/4.98/7.11/9.68 5.11/7.66

Depending on the results of practical studies, we accept this height as h = 0.2 m . We take the density of the crushed p ash q = 30 kg/m 3 , and the coefficient of use of the tape surface is k= 0.85. The productivity of the technological process in cotton ginning enterprises varies around 8-12 t/h. The result obtained by H calcu-

lation falls within this range, and based on this, it can be said that the dryer is new It meets the rational productivity requirements of modern cotton ginning enterprises. Similarly, as the value of cotton bed height increases, the dryer efficiency increases, and the increase in efficiency is more intense as the belt speed increases.

Based on the obtained results, it will be possible to ensure the necessary drying efficiency by controlling the dryer's performance through the second parameter, taking one of the belt speed or the height of the cotton layer as constant. When drying cotton raw materials in a layer under the influence of infrared radiation based on functional ceramics, it is necessary to determine the drying mode, that is, the time required to dry the material's moisture to the specified moisture level, which depends on the height of the cotton raw material layer (Figure 2).

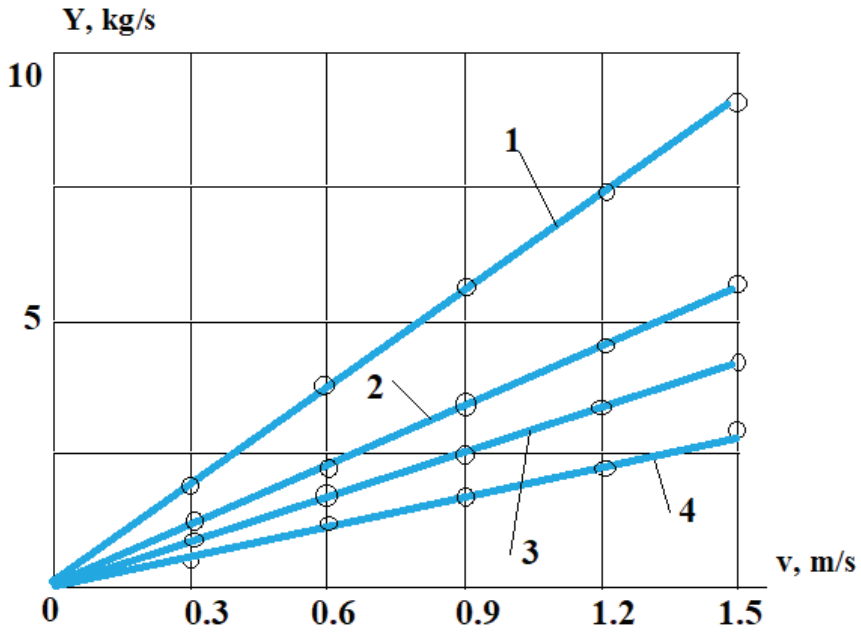

Figure 2. Effect of Belt Speed on Dryer Performance

Production test of the developed infrared drying device based on functional ceramics at the Baghdad cotton ginning plant Selective variety S-6524, industrial variety II, class II, moisture 10.4 %, impurity 4.1 %, hand-picked and selective variety S-6524, industrial variety III, class II, moisture 13.6 %, impurity 7,8 %, was spent on raw cotton, hand-picked, each batch consisting of 50 tons.

CONCLUSION AND RECOMMENDATIONS

The theoretical analysis of ensuring a cotton layer on a conveyor belt demonstrates that the stability and continuity of the layer depend on three core factors: the mechanical characteristics of the conveyor system, the physical properties of cotton fibers, and the regulation of technological parameters such as speed, vibration, and pressure. By establishing an optimal balance among these factors, it becomes possible to minimize material loss, improve fiber alignment, and enhance the efficiency of downstream processing. The study confirms that proper theoretical grounding provides a reliable basis for designing more effective cotton transport systems. Based on the analysis we have conducted, we can make the following suggestions:

Optimization of Conveyor Parameters – It is recommended to maintain an adjustable conveyor belt speed and controlled vibration to ensure uniform layering of cotton and to prevent accumulation or thinning of fibers.

Integration of Monitoring Systems – Installing real-time monitoring and feedback systems (e.g., optical sensors or weight detectors) will help regulate the thickness and evenness of the cotton layer, thereby increasing process stability and product quality.

Application of Advanced Materials and Designs – Using specialized belt surfaces and improved roller systems with anti-static and anti-slip properties can significantly reduce cotton fiber loss and improve energy efficiency of the overall process.

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