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ANALYSIS OF THE EFFECT OF THE DYNAMIC MESH SURFACE OF SEPARATOR DEVICE ON COTTON PIECES

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ANNOTATSIYA

Maqolada paxtani havodan ajratuvchi separator qurilmasining takomillashtirilgan konstruksiyasi nazariy asoslangan bo‘lib, unda qurilmaning ishchi kamerasida to‘rli yuza avvalgi analoglariga nisbatan hajmini o‘gartirilib, uni harakatlanadigan qilib o‘rnatilgan va matematik modeli ishlab chiqilgan hamda grafiklar qurilgan.

Kalit so‘zlar*: paxta, tola, havo oqimi, separator, qurilma, ishchi kamera, to‘rli yuza, vakuum-klapan, yot aralashmalar, harakat.*

ANNOTATION

The article theoretically substantiates the improved design of a cotton separator device. In the device’s working chamber, the mesh surface has been modified in comparison to previous analogs by increasing its volume and making it movable. A mathematical model has been developed, and graphs have been constructed.

Keywords: *cotton, fiber, air flow, separator, device, working chamber, mesh surface, vacuum valve, foreign impurities, movement.*

In today's world, as in all fields, special attention is being paid to the introduction of innovations with high efficiency in the cotton cleaning sector, the creation of resource-efficient technologies, and the improvement of existing equipment and technologies to enhance the quality of the products being produced.[1.2]

It is known that in cotton ginning, a pneumatic transport device is widely used to supply water to seed cotton ginning equipment [3]. This system consists of several devices, the main element of which is the separator device. The main task of the separator device is to separate the seeded cotton transported by the air flow from the air flow after it has been delivered to the destination [4].

Today, there are many types of separator devices, and their designs have been improved for several years. The most common among them is the SS-15 cotton separator device. But despite this, this separator device has its own shortcomings, and they affect the process of separating cotton from the air flow. The most important of these shortcomings is damage to the seeds as a result of hitting the working chamber of the seeded cotton separator at high speed[5,6]. Also, in the process of soaking with the help of a cotton scraper stuck to the mesh surface of the SS-15 separator, the fibers are damaged by the seed, and as a result of the cotton piece absorbing air from the mesh surface, the process of artificial aging occurs [7, 8]

Therefore, by introducing a new cotton separator device to a cotton ginning enterprise, it is advisable to eliminate the condition of cotton in the separator working chamber and increase its productivity (Figure 1).

Figure. 1. Proposed cotton separator device

1-Inlet pipe,2-Working chamber,3-Guide,4-Mesh surface conveyor, 5-arrier, 6-Rollers,7-Brush drum,8-Vacuum valve,9-Air suction pipe.

Mathematical model of processes occurring in the device

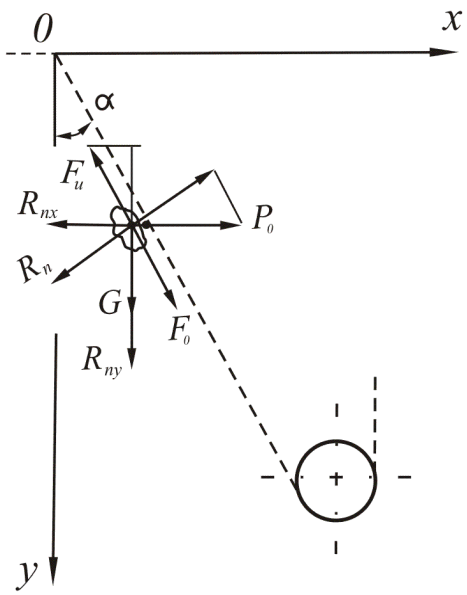
Cotton pieces entered the separator working chamber with the help of air in a vertical direction $\angle\alpha$ hits the mesh conveyor belt forming a corner (Fig. 2). Cotton particles move down the mesh surface under their own gravity. A certain part of the air flow is absorbed through the slits of the mesh surface in its direction. The mesh surface is in the form of a conveyor belt, which moves regularly. In the process of separating the cotton particles from the air, they move along the mesh surface, sticking to it. After the mesh surface and cotton raw material have traveled a certain distance, the cotton raw material is separated from the mesh surface using a brush drum located at the bottom. The separated cotton raw material is thrown into the bottom of the device and is discharged from there through the vacuum valve [9,10]. When the cotton raw material sticks to the mesh surface, as a result of air absorption from the mesh surface, the process of cleaning from the small impurities in the cotton raw material in a passive

state occurs. In this process, the angle formed by the mesh surface plane with the vertical direction ∠α also has an effect on the process of separating cotton particles from the air [11].

Figure 2. Exposure of cotton to a moving mesh surface

It is important to study the separation process and the laws of movement of cotton particles along the mesh surface. [12].

The forces affecting the movement of cotton particles along the mesh surface in the separator working chamber are: (Figure.3).



(Figure-3) **Forces affecting the movement of cotton particles along a mesh surface**

The forces affecting the movement of cotton particles along the mesh surface are:

$P_0 = CV_0^2$ – aerodynamic lifting force of air flow;

$R_n = P_0 \cos\alpha$ – aerodynamic pressure force;

$G = mg$– the force of gravity on a piece of cotton;

$F_{uu} = f \cdot R$ – the force of friction between the piece of cotton and the mesh surface;

f– coefficient of friction;

F_0– mesh surface conveyor belt cotton traction force;

We calculate the projections of the forces acting on the piece of cotton on the ox and ou:

$$\begin{cases} F_x = \sum (F_i)_x = -R_{nx} - F_{ux} - F_0 \sin\alpha \\ F_y = \sum (F_i)_y = G + R_{ny} - F_{uy} + F_0 \cos\alpha \end{cases}$$

or:

$$\begin{cases} F_x = -P_0(\cos^2\alpha + 0{,}5 \cdot f_0 \sin 2\alpha) + F_0 \sin\alpha \\ F_y = mg - 0{,}5P_0(\sin 2\alpha - f\cos^2\alpha) + F_0 \cos\alpha \end{cases}$$

If we introduce the following definition:

$$\begin{cases} \kappa_{11} = \cos^2\alpha + 0{,}5f \cdot \sin 2\alpha \\ \kappa_{22} = \sin 2\alpha - f \cdot \cos^2\alpha \end{cases} \quad (1)$$

Projections of all forces acting on a piece of cotton on the x and ou - axes are as follows:

$$\left.\begin{array}{l} F_x = -\kappa_{11}P_0 + F_0 \sin\alpha \\ F_y = mg + \kappa_{22}P_0 + F_0 \cos\alpha \end{array}\right\} \quad (2)$$

In this case, we write the differential equations of motion of cotton pieces along the grid surface as follows:

$$\left.\begin{array}{l} \ddot{x}(t) = \frac{F_x}{m} \\ \ddot{y}(t) = \frac{F_y}{m} \end{array}\right\} \quad (3)$$

Here: m is the mass of a piece of cotton;

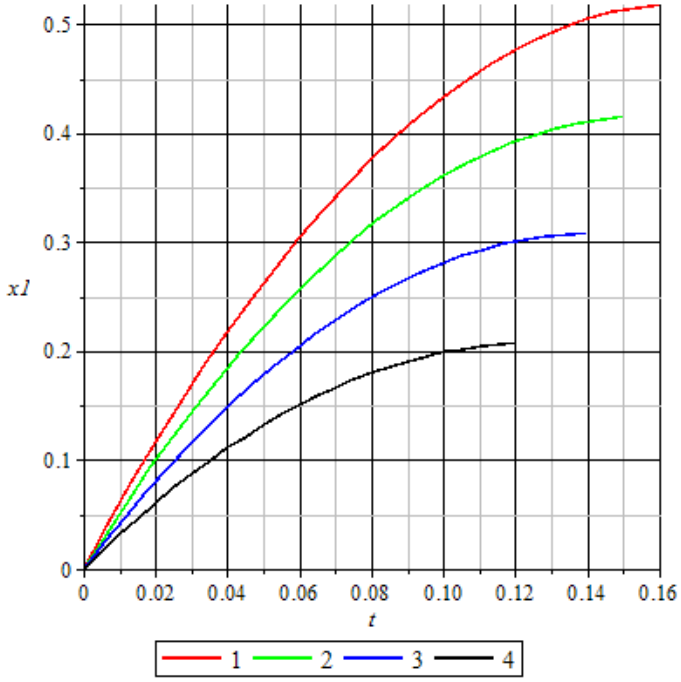
(3) - the system of differential equations was integrated under the following (4) initial conditions, and corresponding graphs were obtained on the basis of the MAPLE-17 program 4÷9 - Fig. [13,14].

Prerequisites:

$$\left.\begin{array}{l} x_i(0) = 0 \\ y_i(0) = 0 \\ \dot{x}_i(0) = \vartheta_{ox_i} \\ \dot{y}(0) = \vartheta_{oy_i} \end{array}\right\} \quad (4)$$

Analysis of results:

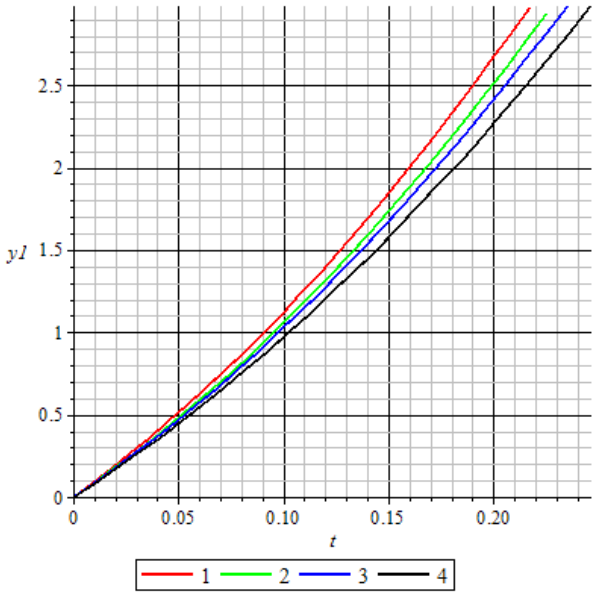
The graphs in Fig. 4.5 show the patterns of changes in the laws of movement of cotton pieces in the horizontal - axis and vertical ou - directions depending on time As can be seen from the graphs in Fig. 4, the process of separation of cotton pieces from the mesh surface is accelerated as the deviation angle of the mesh conveyor surface in the vertical direction increases.



(Figure 4) The pattern of changes in the movement of a piece of cotton in the OX-coordinate direction over time and at different angles of deviation.

$1)\alpha = 30^0, 2)\alpha = 35^0, 3)\alpha = 40^0, 4)\alpha = 45^0.$

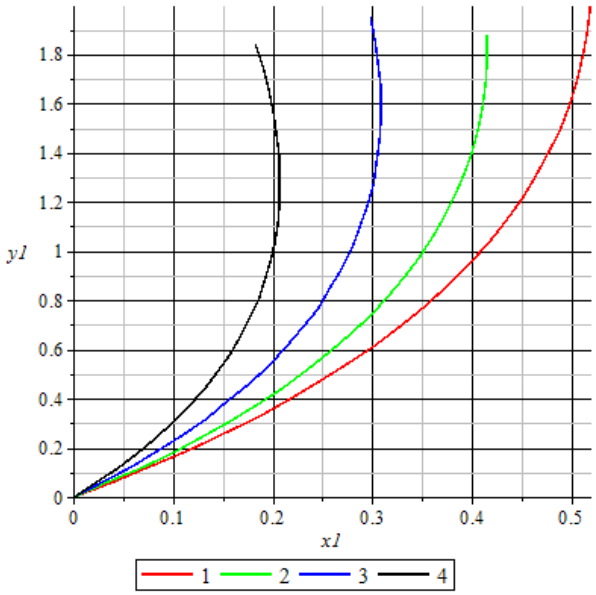
In particular, if the cotton particles separate from the mesh surface at t=0.14 sec, continue moving in the vertical direction and move to the next process, while this process occurs at t=0.12 sec .This, in turn, separates the air from the cotton pieces, that is, speeds up the separation process.



(Figure 5). The pattern of changes in the movement of a piece of cotton in the direction of the OU-coordinate over time, at different angles of deviation.

$1)\alpha = 30^0, 2)\alpha = 35^0, 3)\alpha = 40^0, 4)\alpha = 45^0.$

The graphs in Figure 6 show the law of changing the movement of a piece of cotton in the vertical ou - direction depending on the horizontal axis - direction.



(Figure 6) The law of change of the cotton piece in the direction of the OU-coordinate and its movement in the direction of the OX-coordinate, at different α-deviation angles. $\angle\alpha = 30^0$

$1)\alpha = 30^0, 2)\alpha = 35^0, 3)\alpha = 40^0, 4)\alpha = 45^0.$

If there is an angle of deviation of the surface of the conveyor belt from the vertical$\angle\alpha = 30^0$

$$\begin{cases} x_y = 0{,}4м \\ y = 1м \end{cases}$$

If the cotton piece separates from the mesh surface and goes to the next process,$\alpha = 45^0$

$$\begin{cases} x_y = 0{,}2м \\ y = 1м \end{cases}$$

This process is happening. That is, increasing the angle accelerates the process of separating cotton particles from the air.

Graphs 7 and 8 show the laws of change of the horizontal and vertical velocities of a piece of cotton over time - t.

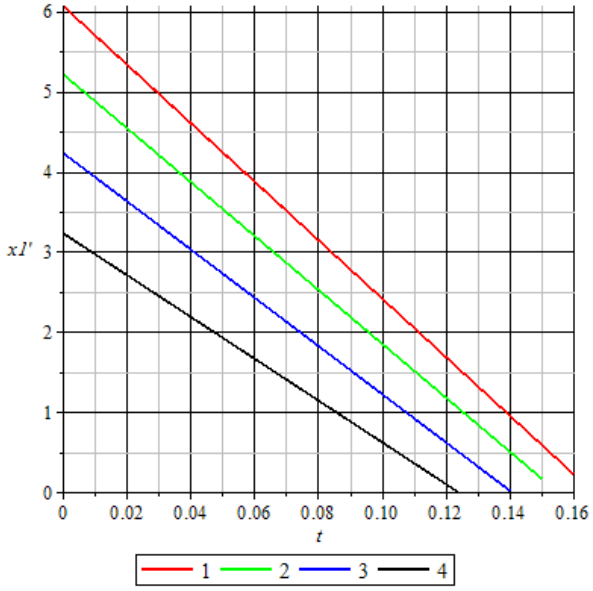


Figure 7. The law of change of the speed of movement of a piece of cotton in the OX-coordinate direction over time, at different α-deviation angles.

$1)\alpha = 30^0, 2)\alpha = 35^0, 3)\alpha = 40^0, 4)\alpha = 45^0.$

Angle of deviation $\angle\alpha$– it can be observed that the horizontal speed decreases sharply with the increase of . However, it can be observed that this process increases in the opposite direction in the vertical direction.

Figure 8. The pattern of changes in the speed of movement of a piece of cotton in the OU-coordinate direction over time, at different α-deviation angles.

$1)\alpha = 30^0, 2)\alpha = 35^0, 3)\alpha = 40^0, 4)\alpha = 45^0.$

Figure 8. a piece of cotton in graphics $V_y(t)$– vertical vertical speed $x(t)$– the law of change depending on the coordinate is given.

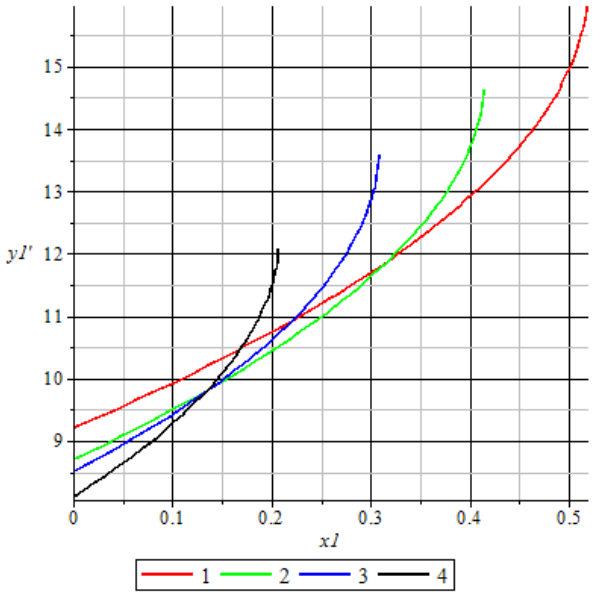


Figure 9. The law of change of the speed of movement of a piece of cotton in the OU-coordinate direction, in the horizontal direction, at different α-deviation angles.

$$1)\alpha = 30^0, 2)\alpha = 35^0, 3)\alpha = 40^0, 4)\alpha = 45^0.$$

In this case $V_y(t)$ – speed intensity $\angle\alpha$ – as it passes faster at a large value, and slower at a small value.

Conclusions

1. The differential equations of motion of cotton particles along a meshed surface were constructed.
2. The angle of deviation of the mesh surface $\angle\alpha$ graphs of the law of motion of a piece of cotton in the horizontal and vertical directions depending on time - t were obtained.
3. In the same way, the laws of change of cotton pieces over time were also obtained, and their graphs of the angle of deviation of the mesh surface at different values were constructed.
4. The mesh surface is partially self-moving, accelerates the separation process of cotton particles, and cleans small impurities from it.

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