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## Theoretical Study of Changes in Air Velocities and Consumption in a Cotton Separator Working Chamber

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**ANNOTATION:** The article examines the change in air consumption entering and leaving the working chamber of the separator device that separates the transported cotton from the air in ginneries.

**KEYWORDS:** cotton, separator, mesh surface, air, working chamber, pneumatic transport, suction, vacuum-valve, seed, fiber.

Today, on the basis of the production and deep processing of cotton fiber, which is the main textile raw material, the country is taking comprehensive measures to increase the competitiveness of a wide range of high quality and low cost textile and light industry products. The Action Strategy for the further development of the Republic of Uzbekistan for 2017-2021, in particular, sets the task of "increasing the competitiveness of the national economy, reducing energy and resource consumption in the economy, the widespread introduction of energy-saving technologies in production."In carrying out this task, including the creation of an efficient technology for transporting cotton to the production process and separating cotton from the air, the development of a cotton separator design with low aerodynamic resistance that does not adversely affect product quality is an important issue. As a result of research conducted in the process of separation of cotton from the air in the separator device in cotton gins, it was found that it is shaken. It can be seen that the cotton entering the separator working chamber hits the separator working wall and as a result of separating the cotton stuck to the mesh surface with a squeegee, it has a negative effect on the quality of cotton.

Improving the separator device and preserving the natural properties of cotton is one of the current challenges facing network enterprises today. In the article, we theoretically study the movement of cotton entering the separating working chamber in the working chamber and the flow of air entering and leaving the separating working chamber from the mesh surfaces.

If the vertical cross-section of the separator working chamber is taken as in Fig. 1, we consider the change in air velocity and flow along the intervals in the drawing.



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Figure 1. Air velocities in the separator working chamber and change in air consumption 1) inlet pipe, 2) working chambers, 3) mesh surfaces

In the experiment, it was found that when the cotton is sucked from the bungee (bunt) through the pipes, at the inlet section, the air velocity is  $v_0 = 20 \text{ m}$  /, the cross-sectional surface of the pipe is  $S_0 = \frac{\pi D_0^2}{4} = \frac{3.14 \cdot (0.4m)^2}{4} \approx 0.12 m^2$ . From this the air consumption will be  $Q_0 = S_0 \cdot v_0 = 0.12 \cdot 20m^3 / s = 2.4m^3 / s$ . This air flow is constant until the separator inlet surface. That is, the inlet of the separator is a rectangle:

 $a_0 = 1m, \ b_0 = 0.3m, \ S_1 = a_0 b_0 = 0.3m^2$  has a surface.

a) Variation of air velocity and flow for the O-A interval.

(1)  $Q_0 = Q_1$  From the equation of air flow equilibrium,  $v_{OA}$  – we find the velocity::

$$Q_{1} = S_{1} \cdot v_{OA}; \ Q_{0} = 2,4m^{3} / s$$
(1) from: 
$$\begin{cases} v_{OA} = \frac{Q_{0}}{S_{1}} = \frac{2,4m^{3} / c}{0,3m^{2}} v_{OA} = 8m / s \text{ air..speed}; \\ Q_{OA} = Q_{0} = 2,4m^{3} / s \text{ air;..consumption} \end{cases}$$
(2)

6) A-V is the variation of air velocity and flow from the inlet part of the working chamber to the mesh surface. We calculate the  $S_x$  – cross-sectional area,  $v_x$  – velocity and  $Q_x$  – air flow of the working chamber at arbitrary cut-x from the interval A-V as follows.

$$0 \le x \le 0.2 \ m$$
  
$$S_x = a_1 \cdot b_1 = 1,7 + (0,6+x) = 1,02 + 1,7x;$$



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$$\begin{cases} v_x = \frac{S_1}{S_x} v_{OA} = \frac{0.3}{1.02 + 1.7x} \cdot 8 \, m/c = \frac{2.4}{1.02 + 1.7x} \, m/s \\ Q_x = S_x \cdot v_x = (1.02 + 1.7x) \frac{2.4}{1.02 + 1.7x} \, m^3/s \end{cases}$$
(3)

If, the parameters in the input section of the A-V interval

$$x = 0: \partial a \qquad \begin{cases} v_x = 2, 3 m / s \\ Q_x = 2, 35 m^3 / s \end{cases}$$
as,

*A-B* while in the exit section:

$$x = 0,2 \, \text{m}: \begin{cases} v_x = 1,78 \, \text{m/s} \\ Q_x = 1,36 \cdot 1,78 \approx 2,42 \, \text{m}^3 \, \text{/s} \end{cases}$$

Between the intervals, the air flow balance is maintained.

B) In the V-D interval, the change in air velocity and flow along the mesh surfaces of the working chamber (Fig. 2).

Figure 2 shows a top view of a working chamber with mesh surfaces on both sides. The flow rate of the air and cotton mixture entering this space will be directed towards the mesh surfaces. As a result, the flow velocity in the OX-

axis and OY-axis directions (projections) is determined by the following expressions:  $0 \le \varphi \le \varphi_0$ 

$$\begin{array}{c} v_x = v_{AB} \cdot \cos \varphi \\ v_y = v_{AB} \cdot \sin \varphi \end{array}$$

$$(4)$$



Figure 2. The direction of air entering and leaving the mesh surfaces in the separator working chamber

It is known that the air flow VDD1V1 - the movement along the section is symmetrical about the OX-axis and exits the mesh surface in the form of an OVD-triangle. An artificial vacuum is created on the ODD1-triangular section, and the cotton separated from the air hits the back wall of the working chamber due to the force of inertia and moves on to the next process. In terms of the ratio of the triangular surfaces, 50% of the cotton raw material entering the working chamber is directed straight to the back of the working chamber. The remaining 50%, with the air mixture, moves towards the mesh surface. Sticking to the mesh surface, it is separated using a squeegee and proceeds to the next process. Let us consider the change in the velocity and flow rate of air flow over the surface of the OVD-triangle. Calculation of air velocity and flow in the OX-axis (horizontal) direction.

We calculate the  $S_x$  – surface with  $v_x$  – velocity in section X-X:



Here:

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$$S_{x} = 1 M \cdot \frac{D-x}{D} \cdot h_{0} = \frac{(1-x) \cdot 1,7}{2} = 0,85(1-x)$$

$$0 \le x \le D = 1$$

$$\begin{cases} \upsilon_{x} = \frac{S_{x}}{S_{x}^{0}} = \frac{0,85(1-x)}{1,7} \upsilon_{AB} \\ Q_{x} = S_{x} \cdot \upsilon_{x} \\ v_{AB} = 1,78 \text{ m/s} \end{cases}$$

$$v_{AB} = 1,78 \text{ m/s}$$

$$v_{AB}^{y} = \upsilon_{AB} \cdot \cos \varphi$$

$$0 \le \varphi \le \varphi_{0}$$

$$x = 0 : \partial a \qquad \begin{cases} v_{x} \approx 0,89 \text{ m/s} \\ Q_{x} \approx 0,75 \text{ m}^{3} \text{ / s} \end{cases}$$

$$x = d = 1 M \ \partial a : \qquad \begin{cases} v_{x} = 0 \\ Q_{x} = 0 \end{cases}$$
(5)

Speed and air consumption are zero.

OY-Variation of air flow along the axis ( $U_y$  perpendicular to):

 $V_{v}$  - perpendicular section of velocity;

 $S_v$  - we calculate:

$$S_y = H \cdot \frac{y}{h_0} m^2 = \frac{y}{h_0} m^2$$

speed:

$$v_{y} = \frac{S_{y}}{S_{y,\phi,\omega}} v_{AB} \cdot \sin \varphi$$

Here:  $S_{y.\phi.o.}$  - useful part of the mesh surface;  $S_{y.\phi.o.} = 0.043 m^2$ ;  $h_0 = 0.85 m$ ;  $\sin \varphi_0 = 0.79$ ;  $v_{AB} = 1.78 m/s$ .

$$0 \le y \le h_0 = 0.85 m$$

In this case: Speed will have this expression.

$$v_{y} = \frac{y}{0,85 \cdot 0,43} 1,78 \cdot 0,79 \ m/s$$
$$y = 0; \partial a \begin{cases} v_{y} = 0; \\ Q_{y} = 0; \end{cases}$$

the center point is the velocity value at 0.

 $y = h_0 = 0.85 m$  - velocity on the mesh surface



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$$v_y = \frac{0.79 \cdot 1.78}{0.043} = 32m/s$$

This speed corresponds to the speed at the time of the experiment at the Kosonsoy ginnery.

$$v_y^{maxc} = 31m/s$$
$$v_y^{ha3} = 32m/s$$

Air consumption:

$$Q_y = S_y \cdot v_y = 0,043 \cdot 31 \, \text{m/c} = 1,43 \, \text{m}^3 \, \text{/s}$$

Given that the mesh surface is evenly spaced on both sides of the separator,

$$Q_{uukuo}^{Ha3} = 2Q_y = 2 \cdot 1, 4 = 2,8 \ m^3 \ / s$$

Hence, we can see the equality of air flow entering the separator working chamber and exiting the mesh surfaces.

$$Q^{max} = 2,4 m^3 / s$$
  
 $Q_y^{max} = 2,8 m^3 / s$ 

 $\Delta Q = 0.46 \ m^3 \ s$  - air consumption difference, we can see that it increases due in part to the extra air absorption from the vacuum valve and the holes left open.

**Conclusion.** Studies have shown that it is necessary to create a new improved separator device that will prevent the cotton entering the separator working chamber from encountering the mesh surface, damage to the fiber and the seed, and the release of free fibers from the mesh surface. In the advanced separator device, the cut should be directed along the OBD-triangular surface, and the cotton pieces moving towards the mesh surface should be directed to the DD1-cut. As a result, cotton products are able to maintain their original quality by developing efficient designs of separator working bodies.

#### REFERENCES

- 1. Muradov R. Salohiddinova M. Mamatqulov O., Investigation of Separating Small Impurities and Heavy Compounds Using the Cotton Separator Equipment. American Journal of Science, Engineering and Technology. USA. 2017; 2(2): 72-76. http://www.sciencepublishinggroup.com/j/ajset. doi: 10.11648/j.ajset. 20170202.13.
- Mahkamov A. Muradov R. Mamatqulov O., Theoretical Research of the Process of Separating Impurities from Cotton Flow on the Vibrating Inclined Mesh Surface. International Journal of Advanced Science and Technology Vol. 29, No. 7, (2020), pp. 10858-10869
- Mamatqulov O. Сепаратор ишчи камерасини такомиллаштириш. Фарғона политехника институти илмийтехника журнали. Фарғона, 2018. – спец. вып. 160-163
- 4. Обидов А., Султанов М., Маматкулов О. Жинланган чигитларни қайта ишлашда уларнинг хусусиятларига боғлиқлиги тадқиқи. ФарПИ илмий-техника журнали, Махсус сон, №3, 2018 йил, 22-27 б.
- 5. О.Маматқулов, Р.Мурадов., Пахтани қайта ишлаш жараёнида пахтани пневмосепаратор ёрдамида ҳаво оқимидан ажратиб олиш. Замонавий ишлаб чиқаришнинг иш самарадорлиги ва энерго-ресурс тежамкорлигини ошириш муаммолари мавзусидаги Халқаро илмий-амалий анжуман 3-4 октябрь 2018 йил, Андижон 139-142.
- О.Маматқулов, Р.Мурадов. Д.Акрамжонов. Установка нового сепаратора для осуществления процесса отделения хлопка-сырца от воздуха и испытание его новой конструкции. Universum технический науки. № 6 (75) 2020 г





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