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# INVESTIGATION OF THE INTERACTION BETWEEN THE MOVING SEPARATOR SCREEN SURFACE AND THE COTTON MASS

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**Abstract:** This article theoretically substantiates an improved design of a cotton separator device that separates cotton from the air stream. In the proposed modification, the mesh surface in the working chamber of the device has been structurally altered compared to existing analogues — its volume was optimized, and it was mounted as a moving surface. A mathematical model of the process was developed, and corresponding graphical results were obtained to analyze the dynamics of cotton-air separation.

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

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**Introduction.** At present, as in all sectors of the global economy, special attention is paid in the cotton-cleaning industry to introducing innovations that ensure high efficiency, developing resource-saving technologies, and improving the quality of produced goods through the modernization of existing machinery and equipment [1,2]. In cotton-processing plants, pneumatic transport systems are widely used to convey seed cotton for technological processing [3]. This system consists of several units, the main element of which is the **separator device**. The main function of the separator is to separate the transported seed cotton from the air stream after it reaches its destination [4].

Currently, there exist numerous types of separator devices, and their designs have been continuously improved for many years. Among them, the **SS-15 model separator** is the most commonly used. However, despite its popularity, this separator has certain shortcomings that affect the efficiency of separating seed cotton from the air stream. One of the major issues is that when seed cotton enters the separator's working chamber at high speed, the seeds are often damaged upon impact [5,6].

In addition, during the process of removing cotton fibers adhered to the mesh surface of the SS-15 separator using a scraper, both the lint and seeds can be damaged. Furthermore, due to air suction through the mesh surface, an artificial ginning effect occurs, which negatively impacts fiber quality [7,8].

Therefore, introducing a **new design of cotton separator** into cotton-cleaning plants can eliminate the clogging issues in the separator's working chamber, improve performance, and increase operational efficiency (see Fig. 1).

**Mathematical Model of the Process in the Device** Cotton tufts entering the working chamber of the separator together with the air flow strike the mesh

conveyor surface, which forms an angle  $\alpha$  with the vertical direction (see Fig. 2). Due to gravity, the cotton tufts move downward along the inclined mesh surface, while a portion of the air flow passes through the mesh openings and is drawn out.

The mesh surface, made in the form of a conveyor belt, moves continuously. During the separation process, the cotton tufts adhere to the mesh surface and move together with it. After traveling a certain distance, the cotton mass is removed from the mesh by a brush drum located at the lower part of the device. The separated cotton then drops to the bottom of the chamber and exits through a vacuum valve [9,10].

When the cotton adheres to the mesh surface, the suction of air through the mesh helps remove small passive impurities from the cotton material. The angle  $\alpha$  between the mesh plane and the vertical direction has a significant influence on the separation process of cotton from the air stream [11].

$$m \frac{d^2}{dt^2} = F_x, \quad m \frac{d^2 y}{dt^2} = F_y$$

where  $m$  is the mass of the cotton tuft. This system of differential equations was solved using **MAPLE-17** software under the initial conditions (4), and graphical dependencies were obtained for different inclination angles  $\alpha$  [13,14].

Analysis of Results Figures 4 and 5 present the time-dependent motion laws of cotton tufts in the horizontal ( $x$ ) and vertical ( $y$ ) directions.

From Figure 4, it can be observed that as the inclination angle  $\alpha$  of the mesh conveyor increases, the separation of cotton from the mesh surface occurs more rapidly.

For instance, at  $\alpha = 30^\circ$ , the tuft detaches from the mesh surface at  $t = 0.14$  s, while at  $\alpha = 45^\circ$ , detachment occurs at  $t = 0.12$  s.

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This indicates that an increase in the inclination angle accelerates the cotton–air separation process.

Figures 7–9 illustrate the variation of the cotton tuft's horizontal and vertical velocities over time for different inclination angles. As the angle  $\alpha$  increases, the horizontal velocity decreases sharply, whereas the vertical velocity increases accordingly.

Thus, a larger inclination angle enhances the separation rate of cotton from the air stream, contributing to improved cleaning performance.

## Conclusions

Differential equations describing the motion of cotton tufts along the inclined mesh surface of the separator were derived and mathematically analyzed.

For various inclination angles  $\alpha$  of the mesh surface, graphical dependencies of the motion laws of cotton tufts in the horizontal ( $x$ ) and vertical ( $y$ ) directions with respect to time  $t$  were obtained.

Time-dependent motion patterns of cotton tufts were also determined for different inclination angles of the mesh surface, and corresponding graphs were constructed to visualize the results.

It was established that the movement of the mesh surface itself accelerates the cotton–air separation process, while simultaneously contributing to the partial removal of fine impurities from the cotton mass.

## References

1. Khusanov S.M., Makhkamov A.M., Muradov R.M., Karimov A.I. *Separation of raw cotton from the air stream under centrifugal force*. Namangan Institute of Engineering and Technology, Scientific and Technical Journal, 2019, Vol. 4, No. 3, pp. 59–64.
2. Muradov R., Karimov A., Makhkamov A., Mamatqulov O.T. *Study and mathematical modeling of the laws governing the separation of cotton from the air stream*. Monograph, Namangan Publishing House, 2018, ISBN 978-9943-4675-7-6, pp. 182–200.
3. Makhkamov A. *Separator for raw cotton*. Catalogue of the IV Republican Fair of Innovative Ideas, Technologies, and Projects, Tashkent, 2011, p. 105.
4. Makhkamov A., Muradov R. *Improvement of the working chamber of the separator*. Textile Problems, No. 1, Tashkent, 2011, pp. 13–15.
5. Makhkamov A., Obidov A., Muradov R. *Study of the dropping process of cotton in the separator's vacuum valve*. FarPI Scientific Journal, No. 2, Fergana, 2011, pp. 20–24.
6. Mardonov B., Makhkamov A., Karimov A. *Theoretical study of cotton tuft movement in an inclined-profile vacuum valve*. Textile Problems, No. 1, Tashkent, 2012, pp. 8–12.
7. Makhkamov A., Muradov R., Karimov A. *Variation of dynamic pressure forces acting on cotton tufts in the separator's working chamber*. Proceedings of the Republican Scientific-Practical Conference, Namangan Institute of Engineering and Technology, Namangan, 2012.

8. Makhkamov A., Karimov A., Muradov R. *Changes in air velocity and flow rate at the inlet and outlet mesh surfaces of the separator's working chamber*. Proceedings of the Republican Scientific-Practical Conference, Namangan Institute of Engineering and Technology, Namangan, 2012.
9. Muradov R., Makhkamov A., Sarimsoqov A., Isahanov Kh. *Feeder for transferring cotton to pneumatic transport*. Application for Utility Model No. FAP 00871, State Patent Office of the Republic of Uzbekistan, 21.07.2011.
10. Muradov R., Sarimsoqov O., Makhkamov A. *Separator*. Patent for Invention No. IAP04363, State Patent Office of the Republic of Uzbekistan, 25.06.2008.
11. Karimov A., Makhkamov A. *Motion laws of cotton tufts in the separator's vacuum valve sections*. Scientific Bulletin of NamSU, No. 1, Namangan, 2010, pp. 39–42.
12. Muradov R., Makhkamov A., Obidov A. *Theoretical study of cotton tuft motion in the inclined-profile vacuum valve*. Scientific Bulletin of NamSU, No. 1, Namangan, 2010, pp. 46–49.
13. Khojiyev A., Dadazhonov A., Makhkamov A. *Device for cleaning cotton fiber*. Patent for Invention No. IAP03889, State Patent Office of the Republic of Uzbekistan, 18.11.2005.
14. Muradov R., Makhkamov A. *Improvement of the separator design for raw cotton*. Proceedings of the II Republican Scientific and Technical Conference, FerPI, Fergana, 2010, pp. 106–108.

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