

AIRFLOW VARIATION IN PNEUMATIC CONVEYING SYSTEMS

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Abstract: The significance of linking pneumatic transport pipes in cotton ginning factories is discussed in the article. Consideration is given to how air duct sealing affects fan performance and energy usage.

Keywords: Pneumotransport, cross-sectional surface, pipe, cotton, fan, aerodynamic force, cyclone, cotton drum.

Introduction. There is a high demand for clothing and sewing-knitted goods made of cotton fibers in the world, and the issue of increasing the quality and quantity of the product is of particular importance. Today, as a result of the continuous increase in the number of people on earth, the rapidly changing tastes, opportunities, and fashion trends of the population lead to a sharp increase or decrease in the demand for a certain assortment of products. This situation causes the demand for cotton fiber, which is the main textile raw material, to change. The world's largest producers of cotton are countries such as China, USA, India, Pakistan, and Brazil, which produce 70% of the total cotton fiber ¹. In this regard, special attention is being paid to improving consumer characteristics and reducing the cost of low-profitable finished products, which are the most costly, require a long time, and require large labor resources, including in cotton fiber-producing countries.

In the world reduce the consumption of electricity by maintaining the initial quality indicators of raw materials in the processes of picking and transporting raw materials, along with the production, by the strong influence of machines and equipment at all stages of the production of cotton and textile products. scientific research is being conducted. As a result, the initial quantity and quality indicators of cotton will decrease, and the cost of the product will increase. In this direction, among other things, research aimed at creating resource-saving techniques and technologies, automation, and mechanization of processes is considered a priority. At the same time, maintaining the initial quality and quantity indicators of cotton seed and fiber and reducing the consumption of electricity in the transportation of

cotton by pneumatic transport are considered urgent tasks that determine the current state and prospects of the industry.

Materials and methods. Large-scale measures for the production of a wide range of high-quality and low-cost textile and light industrial products based on the cultivation of cotton and its deep processing in our republic, in particular, through the centralization of cotton-textile CLUSTERS are being implemented. In the new development strategy of Uzbekistan for 2022-2026, including "... doubling the production volume of textile industry products, wide implementation of labor productivity improvement programs in industrial sectors, industry the tasks of reducing losses and increasing the efficiency of resource use" are defined ². In the implementation of these tasks, in particular, it is important to create mechatronic systems and software development of the equipment, which do not negatively affect the quality indicators of cotton products and provide low energy consumption modes, especially when transporting cotton by pneumatic transport.

Several well-known foreign scientists made a significant contribution to the theoretical and practical foundations of the pneumotransport process and their development, including G. Cherny, G. Abramovich, A. Altshul, L. Loysyansky, D. Chisholm, Yu. Shmuglevsky, T. Karman, Dakh Hem, Donald W. Van Doorn, Dan S. Wise, Hans Oetiker, Richard D. Johnson, and others.

The scientific works of famous scientists of Uzbekistan are dedicated to the creation of fundamental, theoretical, and practical issues and methodological foundations for the transportation of cotton raw materials and products of our country using pneumatic transport. Among them, BALevkovich, RGMakhkamov, KhaRakhmatullin, KhaZiyayev, R.Amirov, S.Boltaboyev, P.Baydyuk, BMMardonov, S.Saidakhmedov, S.Kadirkhojayev, Kh.Akhmedkhodjayev, R.Muradov, M.Khojiyev, O.Sh. Sarimsakov, Ukhazizkhodzhayev, R. Fayziyev, A. Davidov, NAOrtikov, SASamandarov, A. Burkhanov, AAIsmoilov, ZOShodiyeu, TOShamsutdinov, and other scientists have achieved significant results in the development of the theory and technology of cotton transportation processes.

At the same time, the causes of problems such as the reduction of the initial quality indicators of fiber and seed in cotton transportation by pneumatic transport, its release and destruction in the air that carries it, and the increase in energy costs due to the lack of opportunities to manage work modes at the same rate are all around. problems of development of technical solutions that eliminate these shortcomings have not been disclosed and not sufficiently studied.

The purpose of the research is to maintain the initial quality indicators of cotton products and reduce the consumption of electricity by developing a mechatronic system that controls the operating mode of pneumatic transport.

In technical literature, air density under normal conditions of air temperature $t = 0^{\circ}\text{C}$ and normal atmospheric pressure $P_{atm} = 101,325 \text{ kPa}$ (750 mm mercury column) $\rho_{nn} = 1,29 \text{ kg/m}^3$, and standard conditions $P_{atm} = 101,325 \text{ kPa}$ ($\rho_{ns} = 1,2 \text{ kg/m}^3$ humidity $W = 50\%$; temperature $T = 20^{\circ}\text{C}$ is shown to be equal to.

Results and discussion. Humidity, temperature, and pressure in the air in our country are unique and depend on the seasons and weather. In the measurements we made in October 2021, air temperature $T = 20^{\circ}\text{C}$, pressure is $P_{atm} = 735 \text{ mm}$ 98 kPa, $W = 45\%$; humidity, and our calculations $\rho_n = 1,17 \text{ kg/m}^3$ showed that it is equal to the nominal density of air.

Any deviation of the actual air density from the nominal value leads to its tension: ρ_n

$$\rho_a > \rho_n \quad (1)$$

if there is a dense air environment or an overpressure environment in the air,

$$\rho_a < \rho_n \quad (2)$$

a rarefied air environment or a low vacuum environment occurs.

both sides of the inequality ρ_n :

$$\frac{\rho_a}{\rho_n} = k_3 > 1 \quad (3)$$

overpressure (density) environment,

$$\frac{\rho_a}{\rho_n} = k_3 < 1 \quad (4)$$

there will be a low vacuum environment. Here k_3 is the air tension coefficient. The introduction of the stress coefficient, the concept, and the coefficient, facilitates the implementation of process analysis in theoretical work.

The dynamic pressure can be assumed to be constant for a pipe of the same cross-section because the air velocity varies a little along the length of the pipe. However, static pressure varies greatly depending on the pipe cross-section and length. The pressure after the throttle is distributed over the length and cross-section of the pipe, and the transverse forces R_{st} form the static pressure, and the longitudinal force the dynamic pressure: R_d

$$R_d = \frac{K_b \cdot F_{ab}}{f_q} = \frac{K_b \cdot 0,25 \cdot R_n \cdot \pi d_v^2}{(0,25 \pi d_q^2)}$$

$$R_{st} = \frac{K_k \cdot F_{ak}}{(\pi d_k \cdot L_k)} = \frac{K_k \cdot (P_n - R_d) \cdot \pi d_k \cdot L_k}{(\pi d_k \cdot L_t)}$$

where: K_b va K_k –proportionality coefficients due to longitudinal and transverse forces, respectively; F_{ab} and F_{ak} - longitudinal and transverse forces; d_v va d_k – fan throat and pipe diameters; L_k and L_t – the total and current lengths of the pipeline. With simple substitutions and reductions, we get the following equations for dynamic pressure:

$$R_d = K_b \cdot R_n \left(\frac{d_v}{d_q} \right)^2, \quad (5)$$

for static pressure:

$$R_{st} = K_k \cdot P_n \left[1 - K_b \left(\frac{d_d}{d_k} \right)^2 \right] \cdot \frac{L_k}{L_t}. \quad (6)$$

Proportionality coefficients:

$$K_b = \frac{R_d}{R_n} \cdot \left(\frac{d_v}{d_q} \right)^2, \quad (7)$$

$$K_k = \frac{R_{st}}{R_n} \cdot \frac{d_k^2}{d_k^2 - K_b \cdot d_v^2} \cdot \frac{L_t}{L_k}, \quad (8)$$

K_b and K_k coefficients can be determined using aerodynamic measurements. Considering the equations:

$$K_k < K_b < 1, \quad (9)$$

Conclusions. we can predict that it will happen. Because the static pressure inside the pipe is always lower than the nominal pressure, and the dynamic pressure is lower than the static pressure. Also, in existing fans $d_v > d_q$, that is, the diameter of the fan throat is always greater than the diameter of the pipe, and in some cases, it can be equal to it.

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