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RESEARCH OF THE MOVEMENT OF FIBERS IN THE CONFUSION BETWEEN THE AIR CHANNEL AND THE ROTOR IN A PNEUMO-MECHANICAL SPINNING MACHINE

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Abstract:

Objective. In this paper, we conducted research based on a new experimental approach to describe the airflow in a rotor-spinning machine experimentally. This article studied the movement of fibers in the air channel and the rotor in the pneumomechanical spinning machine. In this case, the airflow speed was changed from 5 m/s to 30 m/s. Differential equations of motion along the OX and OY axis were created considering the air resistance.

Methods. When determining the movement of fibers in a conical channel, the total speed was divided into components, constant values were found, and general equations of motion were derived. Also, time-dependent graphs of the movement of fibers in a conical channel along the OY axis on different surfaces, and time-dependent graphs of the movement along the OY axis at different speeds were obtained.

Results. The results of the study showed that the movement of fibers in the conical channel along the OY axis is a time-dependent graph on different surfaces $S_1=14,51$, $S_2=12,56$, $S_3=10,75$, in the channel time-dependent graphs at a speed of $\vartheta_1 = 30m/s$ $\vartheta_2 = 25m/s$ $\vartheta_3 = 20\ m/s$ were obtained.

Conclusion. The results of the study showed that when the time-dependent graph of the movement of the fibers in the conical channel along the OY axis was obtained on different surfaces $S_1=14,51$, $S_2=12,56$, $S_3=10,75$, the fibers on the small surface were straight. When the velocity is high, the time-dependent graph of the speed of $\vartheta_1 = 30m/s$ $\vartheta_2 = 25m/s$ $\vartheta_3 = 20\ m/s$ in the channel was obtained at high speed.

Keywords: pneumomechanical spinning, separator, air channel, fiber, chamber, cone.

Introduction. Some studies have been done on the airflow in the rotor-spinning machine's confusor. Lawrence and Chen [1, 2] used a high-speed camera to photograph the fiber morphology during fiber transmission and optimized the design of the confusor combined with an empirical formula. Kong and Platfoot [3, 4] found that changing the geometric dimensions of the confusor or the speed of the opening roller affects the shape of the airflow in the confusor. The airflow then changes the configuration of the fibers flowing inside the channel. They also studied the influence of the rotational zones on the fiber configuration during transmission within the channel. Lin et al. [5, 6, 7] reviewed the impact of the geometrical parameters of the confusor and the spatial position between the rotor and the channel on the airflow characteristics in the rotor-spinning machine.

Methods and results. In the cross-section of the fiber-blowing chamber, the full pressure distribution force was measured using a microtube with an inlet diameter of 6 mm, and the statistical pressure was measured using a statistical pressure tube. At the same time, atmospheric pressure-P_a; ambient temperature -t; relative humidity-Rh were measured.

Calculation of the speed of the flow in different sections was carried out by dynamic measurement of dynamic pressure R using a pitot tube, and static pressure R according to the static formula [8, 9].

$$V = \xi\sqrt{\frac{2k\sin\alpha(h-h_0)\gamma}{\rho}} \qquad (1)$$

here

ξ-calibration coefficient equal to 0.98;

k- calibration coefficient of the equipment;

α- micromanometer tube liquid slope angle;

ho- the initial indicator of the micromanometer;

ρ- air density, kg/cm^3;

γ- micromanometer liquid density, g/cm^3;

The density value of alcohol was determined with a simple hydrometer with an accuracy of 0.0001 g/cm3. The relative deviation of density determination for alcohol ranges from 0.800 to 0.820 g/cm3, and is equal to

$$\delta_c = \frac{\Delta\gamma}{\gamma} = \frac{0.001}{0.8} = 0.125\% \qquad (2)$$

The relative error in determining the angle of inclination of the pipe, including the error in the installation of the crossbar, does not exceed 0.2%, and therefore

$$\delta_c = \frac{\Delta\sin\alpha}{\sin\alpha} \simeq 0.2\% \qquad (3)$$

All experiments were performed in triplicate. The required number of measurements was calculated as follows: let δ_s be the systematic error determined by the accuracy class of the instrument or another factor. It is recommended to reduce the random error to such an extent that the error should be less than the systematic one. For this, the value of the absolute error should be smaller than ΔX , δ_s, i.e

$$\Delta\bar{X} \le \frac{\delta_c}{3}; \qquad (4)$$

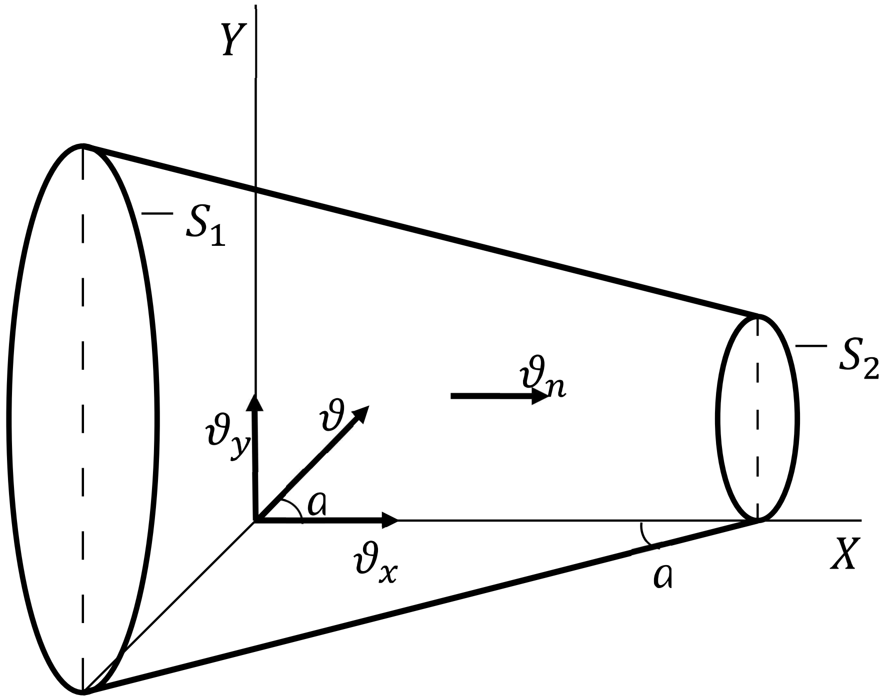

Figure 1. Scheme of movement of fibers in the channel

Taking into account the air resistance, the following expression (1) was created as a differential equation of motion along the OY axis.

Assuming that there is a constant cross-section of the movement channel of the fibers, a coordinate system corresponding to the wall of the movement channel of the fiber on the OY axis was selected. Taking into account the air resistance, the following expression (1) was created as a differential equation of motion along the OY axis.

$$m \cdot \frac{d\vartheta_y}{dt} = \frac{1}{2} \cdot C_y \cdot S \cdot \rho \cdot \vartheta_y^2 \cdot \sin^2 \alpha$$
$$m \cdot \frac{d\vartheta_x}{dt} = -\frac{1}{2} \cdot C_x \cdot S \cdot \rho \cdot (\vartheta_x^2 \cdot \cos^2 \alpha + \vartheta_n^2) \quad (5)$$

Expression (5) represents the differential equations of the movement of fibers along the channel. Here, (S) are the surfaces through which the fibers flow, the resistance coefficient (r), the air density, and (m) the mass of the fibers.

$$\frac{dv_y}{v_y^2} = \frac{C_y \rho S \cdot \sin^2 \alpha}{2m} \cdot dt$$

In determining the movement of fibers in the conical channel, the total speed was divided into components. When constructing a differential equation of motion, differential equations are integrated, initial and boundary conditions are used, invariant values are found, and general equations of motion are derived.

$$v_y = -\frac{2m}{C_y \rho S \cdot \sin^2 \alpha \cdot t} \quad (6)$$

First, the rate of change over time was determined in the differential equation of motion along the Y-axis (6).

In determining the rate of change with time in the differential equation of motion along the Y axis, (m) the mass of the fiber, (Sy) the resistance coefficient, (r) the air density, (S) the surface of the conical channel, (a) the angle and (t) depends on time.

$$Y=-\frac{2m}{C_y\rho S\cdot\sin^2\alpha}\cdot lnt \quad (7)$$

By differentiating the obtained equation (6) with respect to time, the equation of the movement trajectory of fibers along Y was derived (7). Here (m) is the fiber mass, (S_y) is the drag coefficient, (r) is the air density, (S) is the different surface area of the conical channel, (α) is the angle, and (t) depends on time.

In the next case, it was observed that the speed of the surfaces changes in different values over time. The motion of the fibers in the conical tube is integrated with the differential equation along the X-axis. As a result, the speed along the X-axis is determined. It depends on (m) fiber mass, (S_y) drag coefficient, (v_x) air velocity, (S) different surfaces of the conical channel, (α) angle, and (t) time.

$$\frac{dv_x}{v_x^2\cos^2\alpha+v_n^2}=-\frac{C_xS\rho}{2m}\cdot dt$$

$$\frac{dv_x}{v_x^2+\left(\frac{v_n}{\cos\alpha}\right)^2}=-\frac{C_xS\rho}{2m}\cdot\cos^2\alpha\cdot dt$$

$$\frac{\cos\alpha}{v_n}\,arctg\left(\frac{v_x\cdot\cos\alpha}{v_n}\right)=-\frac{C_xS\rho}{2m}\cos^2\alpha\cdot t$$

$$arctg\left(\frac{v_x}{v_n}\cos\alpha\right)=-\frac{C_xS\rho\cdot v_n\cdot\cos\alpha}{2m}\cdot t$$

$$v_x=-tg\left(\frac{C_xS\rho\cdot v_n\cdot\cos\alpha}{2m}\cdot t\right)\cdot v_n\cdot\cos\alpha \quad (8)$$

By differentiating the obtained equation (8) by time, the equation of the movement trajectory of the fibers along the X-axis (9) was obtained. It depends on (m) fiber mass, (S_y) drag coefficient, (r) air density, (v_n) velocity, (S) different surfaces of the conical channel, (a) angle, and (t) time.

$$x=ln\left(\cos\left(\frac{C_xS\rho\cdot v_n\cdot\cos\alpha\cdot t}{2m}\right)\right)\cdot v_n\cdot\cos\alpha\cdot\left(\frac{2m}{C_xS\rho\cdot v_n\cdot\cos\alpha\cdot t}\right)$$

$$x=ln\left(\cos\left(\frac{C_xS\rho\cdot v_n\cdot\cos\alpha\cdot t}{2m}\right)\right)\cdot\left(\frac{2m}{C_xS\rho\cdot t}\right) \quad (9)$$

Equations for the dependence of breaking force on speeds are derived.

Results.

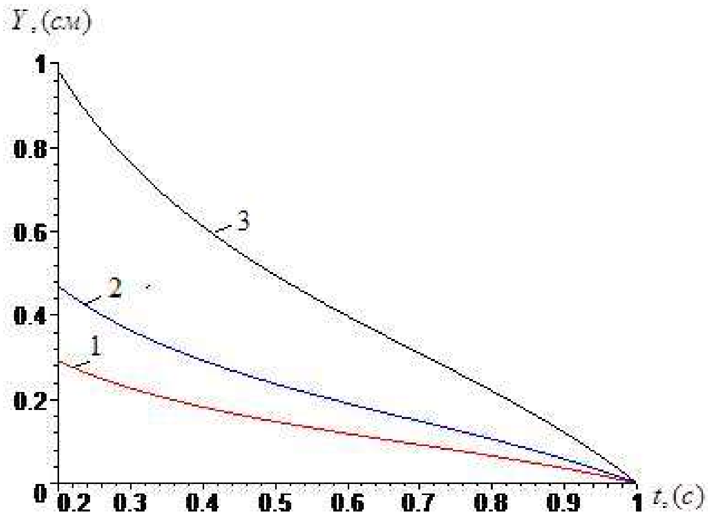

Figure 2. Time-dependent graph of the movement of fibers in a conical channel along the OY axis on different surfaces S_1=19.6, S_2=12,6, S_3=7.1

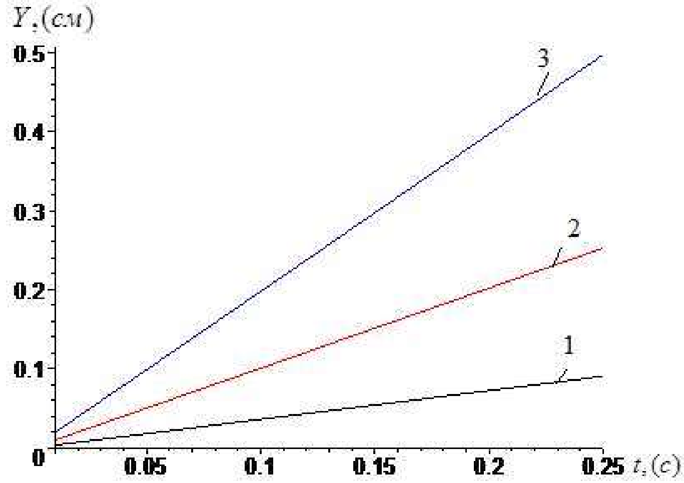

Figure 3. Time-dependent graph of the movement of fibers in a conical channel along the OY axis at different speeds of $\vartheta_1 = 30$m/s $\vartheta_2 = 25$m/s $\vartheta_3 = 20$ m/s

Conclusion. In the research work, the movement of fibers in the air channel and the rotor in the pneumomechanical spinning machine was studied. In the experimental work, the uniformity and stability of the velocity field of each channel for moving fibers in an aerodynamic device were checked. In this case, the airflow speed was changed from 5 m/s to 30 m/s. Taking into account the air resistance, differential equations of motion along the OY axis were created. When determining the movement of fibers in a conical channel, the total speed was divided into components, constant values were found, and general equations of motion were derived. Also, time-dependent graphs of the movement of fibers in a conical channel along the OY axis on different surfaces were obtained. The results of the study showed that when the time-dependent graph of the movement of the fibers in the conical channel along the OY axis was obtained on different surfaces $S_1=14,51$, $S_2=12,56$, $S_3=10,75$, the fibers on the small surface were straight. When the velocity is high, the time-dependent graph of the speed of $\vartheta_1 = 30m/s$ $\vartheta_2 = 25m/s$ $\vartheta_3 = 20$ *m/s* in the channel were obtained at high speed.

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ANALYSIS OF TECHNOLOGICAL PARAMETERS AND PHYSIC-MECHANICAL PROPERTIES OF INTERLOCK KNITTED FABRIC KNITTED FROM COTTON-NITRON YARN

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Abstract:

Objective. For the purpose of effective use of local raw materials in the scientific work was carried out on the technological indicators and physical-mechanical properties of interlock fabric from cotton-nitron yarn. The purpose of research is develop and recommend the new technology of production of interlock knitted fabric with high heat and shape retention properties by using mixed yarn from nitron and cotton.

Method. Theoretical analysis and synthesis methods, the research of the knitting process was used, and experimental researches in the production conditions by Hanma (China) circular knitting machine were carried.

Results. A positive result of the properties of the fabric was achieved by the creation of the technology of knitting interlock fabric using cotton-nitron yarn.

Conclusion. Experimental samples of interlock knitted fabrics obtained from spun cotton and cotton-nitron yarns were taken and their technological indicators and physical-mechanical properties were analyzed.

Keywords: knitting, cotton-nitron, interlock, air permeability, abrasion, rupture, deformation.

Introduction. Double knitted interlock fabric is a derivative of rib stitch. The “Interlock” word is an English word that means "to cross in the form of a cross" and

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