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CONTROL OF COTTON PNEUMOTRANSPORT FACILITY THROUGH SCADA SYSTEM

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Abstract:

Objective. The article reflects the results of a study of changes in air speed and aerodynamic force on the cross section of the pipe during the transportation of cotton by pneumatic transport. It contains conclusions and proposals for the effective management of the cotton pneumatic conveying process.

Methods. Our research shows that the semi-empirical law describing the change in static pressure along a transport line, proposed by us, is well confirmed by experimental data.

Results. In pneumatic transportation of raw cotton, more than half of the installation capacity is spent on moving air. However, the percentage of energy consumption for transporting air at high flow rates is less than at low flow rates, which is also clear - relatively more effort is required to deliver an environment with a high specific gravity at high speeds. provides low speed.

Conclusion The results of the inspection of energy consumption in pneumatic transportation of cotton fibers from one distance to another through the pipeline using aerodynamic air are presented. Based on the results of theoretical and practical research, a reduction in the cost of energy-efficient management of the process of pneumatic transportation of cotton has been achieved.

Keywords: cotton raw material, pneumatic transport equipment, air speed, pipe, pipe cross-section, diameter, aerodynamic force, inverter, static and dynamic.

1 Air pressure in the pipeline of pneumatic transport and its change

Introduction. The demand for natural products, including fabrics and clothing made from natural fibers, is increasing every year on the world market. This is primarily due to the rapidly growing population.

From this we can conclude that the cultivation of cotton and its processing play an important role in the country's economy, and the reforms carried out in it are connected with the future of the country.

Air transport is the process of purposefully moving a certain object or material from one place to another using directed air pressure, in which air flow plays the role of a carrier element.

The transportability of air has been known to man since ancient times. It has states of rest and motion, and its state of rest is usually temporary. Any change in the external environment - an increase or decrease in temperature, pressure - causes its movement. Depending on the level of this movement, it is called differently. Air moving at the slowest speed is called gentle wind, a gentle breeze when it speeds up a little it's called the wind that shakes the body, breeze, at medium speed it's called wind, and when it accelerates even more it's called a hurricane, tornado. Today, huge opportunities are being created in the Republic of Uzbekistan for private entrepreneurship and small businesses, including for the processing of agricultural products as a result of a number of scientific studies. We conducted our scientific research work at "VEN-KON AIR ENGINEERING" LLC, Namangan city, Namangan region. The process of transporting cotton by air takes place in a closed system isolated from the outside atmosphere. To visualize this process, we will take the simplest aerodynamic device scheme and first consider the laws of air movement in it. The fan or pump is located in the center of the pneumatic device. When the system is at rest, that is, when the fan is not running, it is under the pressure of the outside atmospheric air. In this case, the dynamic pressure is zero, and the pressure inside the pipe is equal to the external atmospheric pressure:

Methods. When the fan is activated, it draws air from the first half of the equipment and blows it to the other side. As a result, there is a vacuum environment (thin air) on one side of the equipment, and a dense air environment (excess pressure) on the other side.

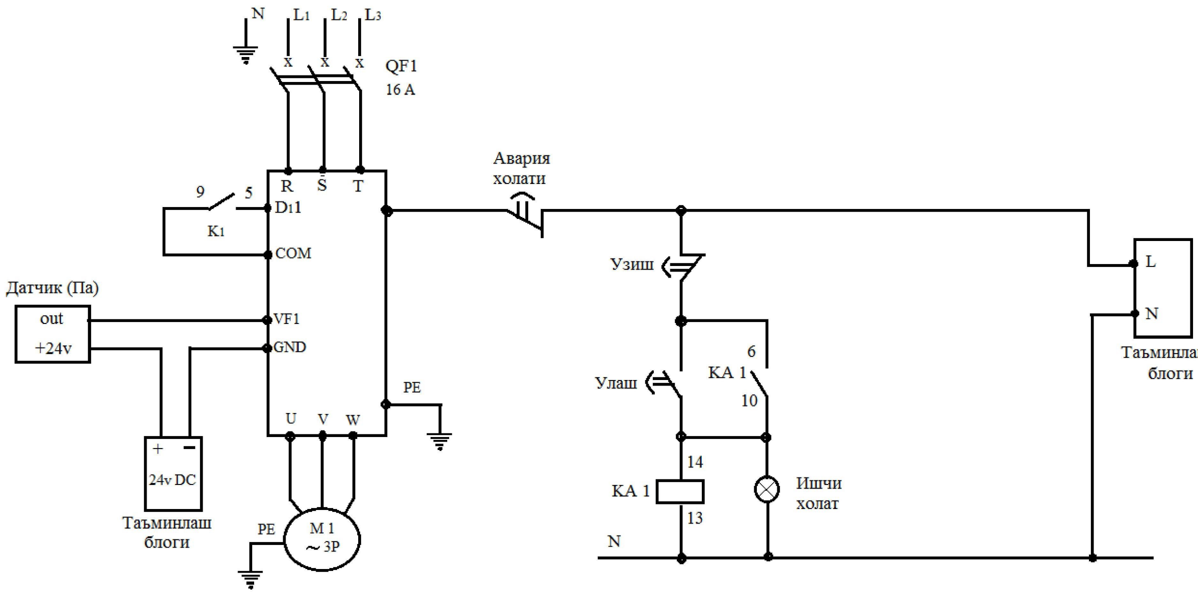


Figure - 1 One-line diagram of the mechatronic control system of the cotton pneumotransport device

Figure 2 shows the measurement results

Figure 3 is an automated setup place of control

The total air pressure P_{tot} that the fan can produce is equal to the sum of the static P_{st} and dynamic P_d pressures in the pipe:

$$P_{tot} = P_{st} + P_d \quad (1)$$

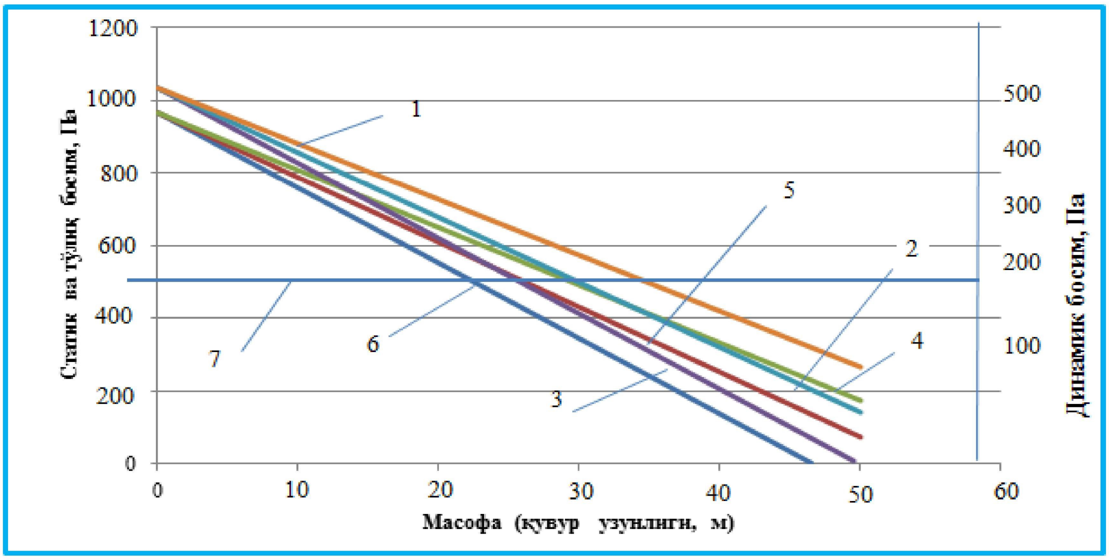
However, the pressure from the pipe to the left, that is, to the fan, is negative - P (vacuum), and the pressure after the fan, that is, to the right, has a positive + P sign. In this case, the static pressure P_{st} is directed vertically from the pipe wall to its center on the suction side, and from the pipe center to its walls on the drive (blower) side.

2. Formation of aerodynamic force and power consumption for pneumatic conveying

Also, the maximum pressure is at the inlet and outlet openings of the fan, that is, on both sides of the fan, and decreases accordingly. We obtained results of static and dynamic pressure of pipes of different lengths during scientific research.

- negative at the entrance, positive at the exit and both ways - to the ends of the pipe.

We need to use the SCADA system to propose a mechatronic control system for a 1.1 kW motor with a 2.2 kW inverter installation with a frequency converter while performing scientific research work. The values of current, voltage, power, frequency, static pressure (P), dynamic pressure (P), velocity in m/s were obtained by adding three different cross-sectional surfaces with diameters of 140, 200 and 300 and extending the distance by adding pipes.



1, 2 and 3 – full, 4, 5 and 6 – static and 7 – dynamic pressure. 1 and 4 – 300 mm, 2 and 5 – 200 mm, 3 and 6 – 140 mm pipe

Graph 1. Distribution of dynamic, static and total pressure along the length of the air pipe

Looking at the results, it can be seen that both the static pressure and the total pressure tend to decrease along the length of the air duct.

3. Power consumption in pneumatic transport and its change

Results. At the same time, the pressure drop in the small diameter air pipe is relatively sharper. For example, in a 140 mm air pipe, the static and total pressure is equal to zero at a distance of 45-50 m. Also, static pressure in a 200 mm pipe (line 2) and full pressure in a 300 mm pipe (line 4) are close to each other. This situation shows that the pressure drop in the 200 mm pipe is close to that of the 300 mm pipe, and their interchange does not lead to a large pressure loss.

A general trend in the graphs is that the aerodynamic drag is relatively high in a small diameter air duct. In fact, many studies have shown that reducing the diameter of the air pipe leads to an increase in its aerodynamic resistance.

If we pay attention to the graphs, at the same air speeds, a relatively large aerodynamic force is generated in pipes with a large diameter. Also, as the speed increases, the difference between the magnitude of the generated force becomes sharper. This is probably the reason why the industry switched to pipes with a diameter of 140, 200, 300 mm. Because when the pneumatic transport equipment was first used in the industry of our country, the diameter of the pneumatic transport pipe was 300 mm. Later, as labor productivity in the industry and, accordingly, the productivity of machines increased, there was a need to increase the productivity of pneumatic transport equipment, and the industry solved the problem by increasing the diameter of the pipe, despite the high consumption of materials and energy.

However, in the current energy shortage, this solution is not justified, and the industry is gradually moving to the use of smaller diameter pipes, and our previous research [1] has theoretically justified this action.

On the basis of the results of scientific research conducted on the improvement of electrical energy efficiency, the introduction and development of a new mechatronic system that controls flow parameters in cotton pneumatic transport, by installing an inverter mechatronic system and software to fan electric motors in cotton primary processing enterprises, air in a new cotton pneumatic transport pipeline a rational control system of the static pressure and speed of the flow was created.

4. Conclusions. A mechatronic system with a rational control of the flow parameters in the pipeline is installed on the stationary pneumatic transport equipment that transports the cotton from the fields to the production workshops at the enterprise belonging to "VEN-KON AIR ENGINEERING" LLC. The installation of an inverter device on the VTs-12 M fan allows to reduce the active and reactive power energy at the time of starting the engine (pushing torque) when transporting cotton in a pneumatic transport, to save the engine and prevent it from burning in case of an accident. Also, by adjusting the air pressure and speed in the pipe according to the distance of transportation, it was found that the quality indicators of the transported cotton components were improved compared to the existing equipment.

Method (method) installation of an inverter mechatronic system with special software for fan electric motors at the enterprise "VEN-KON AIR ENGINEERING" LLC. According to the results of the experiments, it was found that the new device has the possibility of saving electricity by reducing the active and reactive power energy at the time of engine start-up (push torque).

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COTTON PNEUMOTRANSPORT PIPELINE CONTROL THROUGH MECHATRONIC (SCADA) SYSTEM

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Abstract:

Objective. In the article, the results of the research of the change of air speed and aerodynamic force in the cross-section of the pipe during transportation of cotton, seed, lint, fiber waste from the separator cyclone, cyclonic fluff in pneumatic transport are reflected.

Methods. Our research shows that the semi-empirical law describing the change in static pressure along a transport line, proposed by us, is well confirmed by experimental data.

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