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To Study Of The Movement And Throughput Of Cotton Inside Pneumatic Conveying Pipeline

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Annotation.

The article discusses the effectiveness of a pneumatic conveyor plant designed to move cotton in a cotton gin plant. The dependence of the throughput capacity of a cotton pneumatic transporting pipeline on its diameter, pipeline material (that is, on the coefficient of friction of cotton on the inner surface of the pipeline), on the speed of the air flow and on the aerodynamic properties of the cotton particle is analyzed. A rational diameter of the pipeline was proposed, which provides the necessary throughput at the minimum cost of air and energy.

Keywords. Cotton, pneumatic transport, pipeline, throughput, air flow, air pressure, air velocity, air flow, aerodynamic mode, compressor, dynamic pressure, static pressure, cotton friction, coefficient, aerodynamic mixture, discrete atmosphere.

Introduction. When the pneumatic tube material is turned on, the aerodynamic mode of the machine changes completely. There is a force that allows air to penetrate the material, and the material follows the air with the same force. Many scientists believe that only the resistance forces move the object and model the motion parameters of the object depending on the air velocity.

If so, the fans of the pneumatic vehicle should have a large air flow (i.e. dynamic pressure). In practice, fans and pumps (compressors) are used to create more pressure on pneumatic vehicles. The main reason for this is that in pneumatics not only dynamic but also static pressure plays a major role.

1.Main part

The ratio of mechanical energy to liquids in gases and gases or mechanical energy equivalent to the weight of a device is called total pressure. Kinetic energy is called pressure velocity or dynamic pressure. The ratio of the energy of the power of pressure and the potential energy of a state to a unit of weight is called static pressure. Static pressure is a complex physical structure, without an exact mathematical expression for a moving gas. Logically, this pressure corresponds to the size of the air particles on the surface of the base. It can be measured.

This pressure is caused by the volatility of the air. Consequently, moving air particles, as well as any other objects entering the stream, are subjected to static pressure - it pulls it (in the pneumatic transport of the cover) or pushes it (pneumatic transport of the bumper). Therefore, the case included in the pneumatic tube, which includes the movement of cotton raw materials, does not give a real result only in relation to the dynamic pressure. Given these variables, when modeling the processes of pneumatic conveying, it is desirable to choose models that take into account the static air pressure.

Pneumatic transport process is a very complex action. Thus, certain restrictions on training are accepted. Air velocity is usually higher than substance velocity. Therefore, in most theories, the theory of air movement is investigated, assuming that the object is irreversible. In some theories, however, the air is ignored, that is, stillness, and the relative motion of the object is investigated. In addition, in a number of theories, an object in a pneumatic tube is considered a material point or sphere or another specific geometric figure.

Depending on the constraints and how close the model is to the actual process, the results will also be displayed with specific errors. The development of science and computing and technology ensures that the models used will be closer to reality, and as a result, errors are reduced. Unlike our previous research [1, 2], we see a continuous environment for transporting cotton through a pneumatic tube, a discrete environment for cotton raw materials and transportation as a two-component movement of the environment.

2. The main indicators of a two-component environment

One of the main indicators of a two-component environment is the mass **w** concentration and concentration of μ represents the relative volume of components within the airline:

$$w = \frac{W_{п}}{W_{п}+W_{x}}, \quad (1)$$

Mass concentration refers to the relative weight of the components in the aircraft:

$$\mu = \frac{\sigma_{п}}{\sigma_{x}+\sigma_{п}}, \quad (2)$$

Here, the amount of air in the pipeline $W_{п}$ cottons W_{x} - air flowing through m^3; the, $\sigma_{п}$ cotton and σ_{x} air productivity, kg / s

When we use the VTs-12M fan with an average air consumption of 6.0 m3 (or 7.2 kg / s) with an average productivity of 10 tons (or 2.78 kg / s), we will analyze cotton granules with a density of 37.8 kg / m^3, mass and mass concentration with a density of 1.2 kg / m^3:

$$w = \frac{2.78/37.8}{6+2.78/37.8} = 0.012 \ \text{м}^3/\text{м}^3, \quad \mu = \frac{2.78}{2.78+17.2} \quad 0.28 \ \text{кg/кg}$$

These figures are significantly lower than in other industries, such as grain processing, construction, woodworking, mining and pneumonia.
Another indicator of a two-component environment is its average density:

$$\rho = \rho_x + w \cdot (\rho_ч - \rho_x), \quad (3)$$

In accordance with the above, the average density of a mixture of cotton and air varies depending on:

$$\rho = 1.2 + (37.8 - 1.2) \cdot 0.012 = 1.64 \ \text{кg/м}^3$$

Like any conductor, a pneumatic conveyor can carry a certain size, and this determines the overall perfomance of the pneumatic tubes.

3. The throughput of pneumatic transportation

The ability to move depends on factors such as the cross-sectional surface of the airways, friction characteristics of the inner surface, density, speed, shape and size of air and transport, and its analytical expression was not found. Therefore, in its assessment, this mainly relates to experimental equations. Teverovsky E. According to [3], the capacity of the respiratory tract is determined by the maximum concentration of the material, component w_{max}:

$$W_{мax} = 2.15 \cdot \upsilon_ч \cdot g \cdot d \cdot \lambda^{-1.5} \cdot \upsilon_x^{-3}, \quad (4)$$

We analyze the equation for airline diameter and air velocity. Depending on the pneumatic conveying, the air velocity is from 10 to 30 m / s, the diameter of the duct is d = 0.315; 0.355; 0.4 m; coefficient of friction of the diameter of the duct l = 0,152593; 0.148165; 0.139575 Critical speed of planting raw materials transported through the respiratory tract (which is at that speed below and below the bottom of the cotton airline), when the operating temperature is about 12 t / s, when the temperature is = 14.5 m / s, 10t / For equations 12 - 13 m / s analysis is of the equation on a computer is shown in Figure 1.

If we look at the results, we can use a duct with a diameter of 300 mm or less to transport aeration from the current concentration (w = 0.012 m3 / m3). In addition, air extraction on large volumes of the air pipe, for example, on a 400-mm overhead line, can be carried out at a concentration w = 0.2-0.3 m3 / m3 at a speed of 20-25 m / s. At the same time, the relative concentrations of the air flow, the size of the airways and the operational efficiency values for high air velocity values in the compounds have decreased

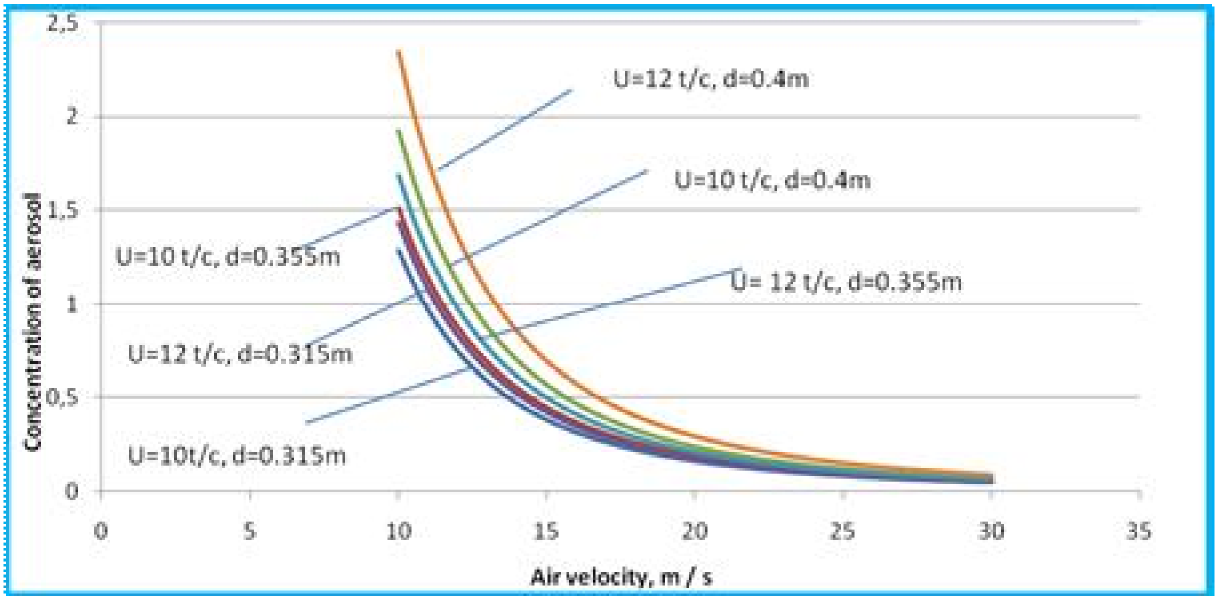

Figure 1 Maximum flow capacity of the pneumatic transport pipeline

This means that the high air velocity for the air pipe does not matter the load on the material being added. However, since these graphs are based on concentrations of materials in the air, it is difficult to assess the ability of air bubbles. Therefore, in order to facilitate the application in practice, we try to create an equation of the ability to work in the form of labor productivity.

(1) in accordance with:

$$W_p = w(\, w_x + w_p\,),$$

After changing the simple form, we can add:

$$W_p = w_x\, w/(1-w), \quad (5)\ .$$

If we assume that W is the maximum value of (5), Wp = Gp / rp; For Wx = Gx / rx (for example, cotton and air flowing in the pipe Gp and Gx, rp and rx cotton and air density), we add the following expression:

$$G_p = 21.092 \cdot (G_x/\rho_x)\cdot\rho_p\cdot\upsilon_{\text{ч}}\cdot d/(\lambda^{1.5}\cdot\upsilon_x^{3} - 21.092\cdot\upsilon_{\text{ч}}\cdot d), \quad \text{кg/s}.$$

Gx / rx = Qx - air flow, m3 / s; Considering that 1 kg / s = 3.6 t / h, the ability of a pipe to work as a formula for labor productivity can be given by the following equation for Gp:

$$G_p = 75.93 \cdot Q_x\cdot\rho_p\cdot\upsilon_{\text{ч}}\cdot d/(\lambda^{1.5}\cdot\upsilon_x^{3} - 21.092\cdot\upsilon_{\text{ч}}\cdot d), \quad \text{tons/h}, \ (6)\ .$$

An analysis of the undesirable parameters obtained for equation (6) (4) is shown in Figure 2. If we refer to this, we see that all curvilinear trajectories have a decreasing characteristic, unlike the flow velocity. If the flow rate increases with other parameters, the airflow performance decreases dramatically. Because the conversion ability varies depending on the cube flow rate.

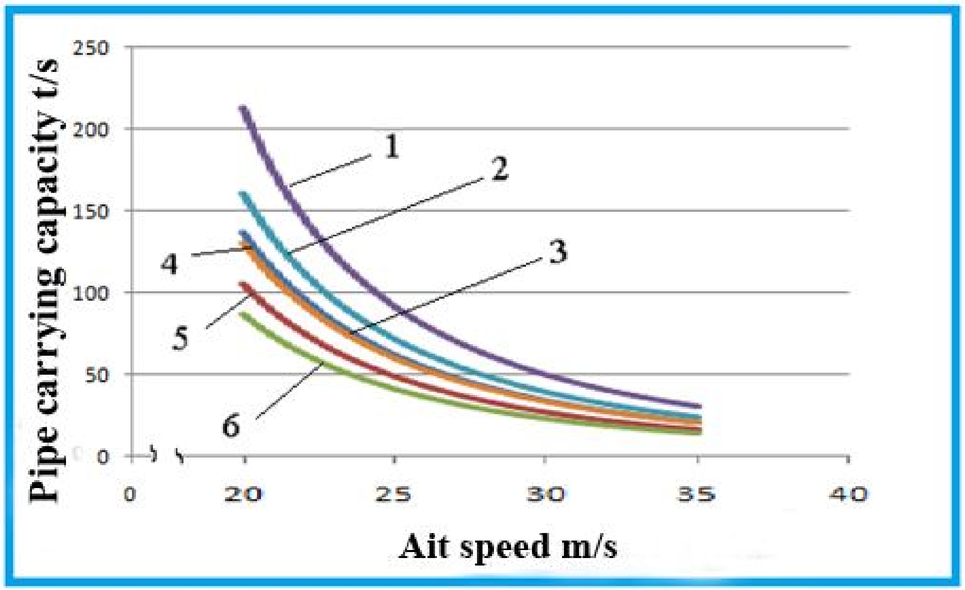

Figure 2 The pipeline throughput depending on the air flow speed.

An air pipe with a diameter of 1.4–400 mm, an air pipe with a diameter of 2.5–355 mm, an air pipe 3.6– 315 mm; 1,2,3 - plowing speed of 12 m / s, 4,5,6 - speed of 20 m / s. Indeed, the amount of time spent on an airplane in an airplane, the higher the air temperature, increases air consumption. This, in turn, leads to a decrease in the concentration of air in the pipe.Since cotton is calculated on the basis of cotton, a decrease in the amount of cotton that corresponds to the consumption of a unit is reflected in a decrease in the airflow capacity. Previously, the density of cotton in the air was reduced by more than 2 times. Consequently, in these calculations, the density of cotton when moving along the pipeline was rp = 25 kg / m3.

According to the analysis of the equation, the pumping speed in an air well of 400 mm is 12 m / s, and the air speed is 25 m / s, 100 tons per hour, at speeds of 30 m / s and speeds of 20 m / s - 35 tons per hour. seems to accept. The airline with a diameter of 355 mm is designed to pump cotton at a speed of up to 12 m / s with a working speed of 25 m / s at a speed of 19 m / s and a spill speed of 20 m / s with an air cushion of 315 mm. while the cotton transfer speed is 12 m / s, and the air speed is 25 m / s, 60 tons per hour, at speeds up to 30 m / s and 20 m / s for pumping speeds up to 20 tons per hour.

Conclusion

The “Pakhtasanoat” (cotton industry) Science Center recommends choosing 70% of the air velocity relative to the calculated values. If we use this, capability of the 400-mm air pipeline has a real winding capacity of 21–60 t / h, 355 mm (from 18 to 40 t / h) and 315 mm (from 11 to 35 t / h). At the same time, a high stock value corresponds to cotton, which has a high moisture content. For companies that require an average of 8-11 t / h, we can recommend air ducts with a diameter of 315 mm and air ducts with a diameter of 355 mm for enterprises that require 12-18 t / h.

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