DEVELOPMENT OF ENERGY-SAVING METHODS IN THE PROCESS OF TRANSPORTING COTTON BY AIR

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Abstract: *Reducing energy consumption during pneumatic conveying cotton is a topical issue at the ginning plants. In this paper we consider the possibility of reducing energy costs by using smaller diameter pipes. It proposed a mathematical model and presents the analysis of energy consumption on parameters of the pneumatic conveyor and flow.*

Keywords: *pneumatic installation, static pressure, dynamic pressure, aerodynamic force, power consumption, raw cotton.*

1. Changing the air pressure in the pneumatic transport pipeline

In the known theories on the pneumatic transport wind power is considered as a function of the square of the speed or airflow[1], [2], [3]. This means that it depends only on the dynamic pressure which, when a complete seal and the pipeline system element is constant, not varying along the length of the tube. However, experience shows that the magnitude of the aerodynamic force is not constant, but varies depending on the length of the tube - a maximum value of the fan and towards the beginning of the pipeline is gradually reduced, just as static pressure [4], [5], [6]. Based on these considerations, we have the task of establishing the influence of the static pressure on the value of wind power.

The total pressure consists of P_p 2 terms, P_d is the dynamic pressure and static P_{st}:

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

The dynamic pressure Pd is, the kinematic energy of the flow, and depends only on its parameters - medium density ρ and speed υ:

$P_d = 0{,}5\,\rho\,\upsilon^2$

Static pressure is the potential energy of the medium position. it is mathematically well described for a fixed environment, but for a moving medium is difficult to describe. Our studies show that we have proposed semi-empirical laws describing the change in the static pressure on the transportation lines are well supported with experimental data [1]:

$P_{см} = P_{н} - Pu = P_{н} - 0.5\,\rho\upsilon^2\lambda\, L/d\,,\ (2)$

Here, $Pu = 0.5\,\rho\upsilon^2\lambda\, L/d$ - static pressure it takes to preodaleniya friction force of the medium on the inner wall of the pipeline, Pa; P_H -rated pressure developed by the fan during normal operation, Pa; ρ - density of the fluid kg / m^3; υ - of the medium speed, m/s; λ- drag coefficient, L- length, d - diameter of the pipeline, m.

According to (1) the force applied to overcome the frictional force must be directed against it and the direction of motion of the medium. Based on this, change the sign between the terms in the (+) in the equation (2):

$$P_{ст} = P_{н} + 0.5\,\rho\upsilon^2\lambda\, L/d \quad , \qquad (3)$$

The total pressure is defined as $P = P_{st} + P_d$. with this in mind (2) comes after some transformation to the form:

$$P = P_{н} + 0.5\,\rho\upsilon^2(\lambda\, L/d + 1)\ , \qquad (4)$$

2. The aerodynamic force and power consumption for pneumatic transport

Move medium in the pipeline produces aerodynamic force F_a and the force of friction F_u seeks to stop the move. A motion to osushestvlyaetsya, as indicated above, should be accompanied by a force equal to F_u but against its direction. Moreover, the aerodynamic force F_a produce dynamic and static pressure and friction force F_u - static. The resulting force F, sposobstvuyushaya movement of the medium is the product of the total pressure and the cross-sectional area of the pipeline:

$$F = P \cdot f = 0.25\,\pi d^2\cdot(P_{н} + 0.5\,\rho\upsilon^2(\lambda\, L/d + 1))\ , \ (5)$$

If you pay attention to the last equation force F uvelichyvaetsya with increasing length L and the drag coefficient decreases with increasing diameter of the pipeline and it is logical, because the greater the transport distance, the more energy it will take. If this power depended on the dynamic pressure, the tightness of the system at full strength would be constant over the entire length of the pipeline. However, according to (4) the value of the aerodynamic force is not constant. After simple transformations, we finally obtain:

$$F = 0.125\,\pi d^2\cdot(\rho\upsilon^2(1 + \lambda\, L/d) + 2P_{сн})\ , (6)$$

This force does the work of A, equal When the system operation:

$A = F\cdot L.$

Through the work done within the time device power consumption is as follows:

$N = A / t = F\cdot L / t$.

The ratio of the distance on time is the average flow rate:

$v_p = L / t$.

In view of the latter, we obtain the dependence of the power expended in moving the environment from the set parameters and flow:

$N = 0.125\,\pi d^2\cdot(\rho\upsilon^2(1 + \lambda\, L/d) + 2P_{сн})\cdot\upsilon_p$, (7).

This formula shows that the power expended in transporting the medium depends largely on the average flow rate, then the parameters from the (inner surface resistance, length and diameter) of the pipeline.

3. Power consumption in pneumatic conveying

Let us analyze the dependence (7). Here, d indicator not only of the pipeline, and the index of the medium, too, because it determines the size of the cross-flow and is equal to the inner diameter of the pipe: d = 0.315; 0.355; 0.4 m. The air density ρ = 1,2 kg / m^3, fuel mixture ρ = 1.65 kg / m^3.

The length of the pipeline will take equal to L = 100 m.

λ - friction coefficient of the medium on the inner surface of the pipeline is[7], [8]:

- When air flows:

$d = 0.315$ м - $\lambda = 0.068$;
$d = 0.355$ м- $\lambda = 0.066$;
$d = 0.4$ м - $\lambda = 0.064$.

-With Movement aeromixture:

$d = 0.315$ м - $\lambda = 0.134$;
$d = 0.355$ м - $\lambda = 0.133$;
$d = 0.4$ м - $\lambda = 0.132$.

(Accepted as the average value of clean air friction coefficients (λ = 0.064 - 0.068), and cotton (λ = 0.2) of the inner surface of the steel pipe).

The analysis is performed on a computer with standard programs, the results of which are presented in graph form in Figure 1, which show that they correctly describe the process: with increasing the flow rate of power consumption increases significantly.

The graphs show that a significant portion of the power consumed for air transportation. Thus, when pipe diameter 0.315 m, a flow rate of 20 m / s is required to move the medium 16 kW of power, and when the raw cotton in the medium increases to the power consumption of 25 kW. Thus, 64% of the power consumed for air transportation.

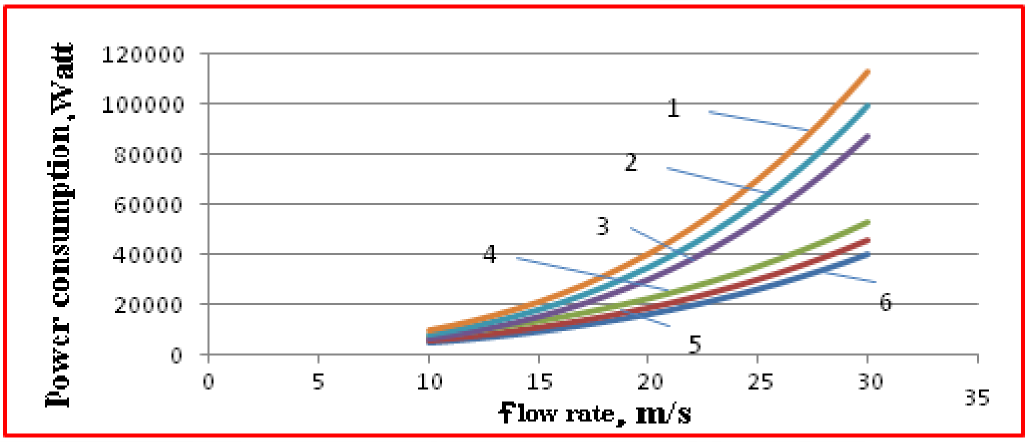

Fig.1. power consumption depending on the type, flow rate, and pipeline parameters. In graphs: 1- d = 0.315m, ρ = 1.2 kg / m3; 2 - d = 0.355m, ρ = 1.2 kg / m3; 3 - d = 0.4m, ρ = 1.2 kg / m3; 4 - d = 0.315m, ρ = 1,65 kg / m3; 5- d = 0.355m, ρ

= 1,65 kg / m3; 6 - d = 0.4m, ρ = 1,65 kg / m3. Thus: 1.2 and 3 - with air movement of 4.5 and 6 - fuel mixture during the motion.

At a speed of 30 m / s is required to move the air 40 kW, and the mixture of air and raw cotton 85 kW, or 48% corresponds to the air flow. With a diameter of 0.4 m, flow rate of 20 m / s is required to move the air 20 kW, and the mixture of air and raw cotton 40 kW. At a speed of 30 m / s is required to move the air 50 kW, and the mixture of air and raw cotton 110 kW. Moreover, the power consumption is 50% and 46% of the total power consumption.

To determine the proportion of the power costs of air transportation and fuel mixture we use the formula:

$$\Delta N_{н} = (Na - Nx) / (0.01Na), \quad (8)$$

Analysis of relationship (8) at flow rates (20 - 30 m / s) is shown in Fig. 2, which show that during the pneumatic transport of seed cotton over half power setting to move the spent air. At the same time, the share of power consumption for air transport at high flow rates is less than the lower, which is also obvious - to give the environment a large proportion of high speeds requires more effort than giving it a lower rate [9], [10].

From the above we can conclude that the relationship (7) correctly describes the power consumption of the process of change of the flow parameters and the pneumatic installation as a whole and may be offered for use in the design of pneumatic conveying systems.

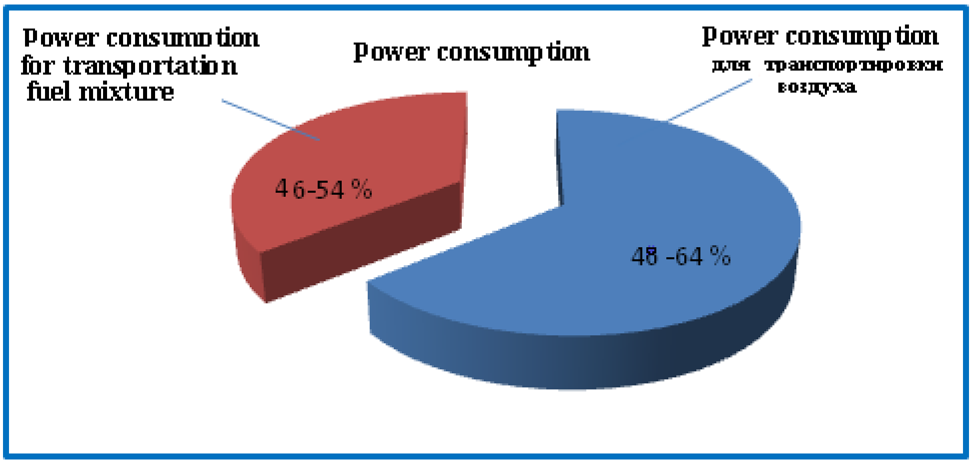

Fig.2. Power consumption proportion of air transportation and fuel mixture

4. Conclusions

1. Research has established that the aerodynamic force that contributes to the displacement of the medium through the pipeline pneumatic transport installation depends on the total pressure of the flow, ie, the sum of the dynamic and static pressures.

2. It was also found that the power expended in transporting the medium depends largely on the average flow rate, then the parameters from the (inner surface resistance, length and diameter) of the pipeline.

3. Analysis of the results of studies power expended in transporting the medium indicates that an increase in power consumption flow rate increases markedly, with a considerable portion of the power consumed for air transportation.

4. It was also found that the diameter of the pipe and the flow rate significantly affect the power consumption of the transportation environment, which leads to the conclusion that the use of smaller diameter pipes at moderate flow rates, thereby reducing power consumption and thus reduce production costs ginneries.

REFERENCES:

1. Loytsyansky L. liquid and gas mechanics. Moscow, Drofa, 2003
2. E. V. Novikov. The study of air flow in the picker section of the unit als-1 and the device separating unrelated fires. Textile industry technology, no. 2 (314) 2009.
3. Zarnitsyna E. G., Terekhova O. N. Ventilation systems and pneumatic transport. Publishing house of the Altai state technical University, Barnaul, 2011
4. Muradov R., Sarimsakov O., S. Khusanov Interplant pnevmotransportnoe of raw cotton: state, problems and prospects. Journal "problems of mechanics", 2014, №2.
5. Garbaruk A., Strelets M., Shur M.. Simulation of turbulence in complex flows calculations. . Saint Petersburg Polytechnic University. Saint-Petersburg., 2012 [4].
6. C. Antimonov, etc. Measurement and calculation of pressure losses in air ducts. Orenburg State University. Orenburg., 2005.
7. Muradov R.. Bases of increase of efficiency of the device for pneumatic transportation of cotton. Monograph. Namangan, 2015.
8. Sarimsakov O. The Change in Air Pressure Along the Length of the Pipeline Installation for PneumaticConveying of Raw Cotton. USA. Journal Engineering and Technology. 2016; 3(5): 89-92
9. Sarimsakov O., Khusanov, S. Abdullaev SH., “Study of motion of air inside duct” of the Namangan engineering-technological Institute. Materials of the Republican scientific-practical conference. Namangan, 2015.
10. Sarimsakov O., Khusanov S. Abdullayev SH., “The Control parameters of the air flow in pneumatic conveying installation Namangan engineering-technological Institute. Materials of the Republican scientific-practical conference. Namangan, 2015.

11. Э.Зикиряев. Пахтани дастлабки қайта ишлаш. Тошкент, “Меҳнат”, 2002.

12. Г.И.Мирошниченко. Основы проектирования машин первичной обработки хлопка. Москва. “Машиностроение”, 1972.

13. Саримсаков, О. Ш., Турдиев, М., Саттаров, Н. М. У., & Турғунов, Д. У. У. (2022). ЛЕНТОЧНЫЙ ПИТАТЕЛЬ ДЛЯ ПОДАЧИ ХЛОПКА В ПНЕВМОТРАНСПОРТ. *Universum: технические науки*, (9-3 (102)), 11-14.

14. Ubaydullaev, M. M., & Makhmudova, G. O. (2022). Medium fiber s-8290 and s-6775 cotton agrotechnics of sowing varieties. *European International Journal of Multidisciplinary Research and Management Studies*, *2*(05), 49-54.

15. Саримсаков, О. Ш., Турдиев, М., Саттаров, Н. М. У., & Турғунов, Д. У. У. (2022). ЛЕНТОЧНЫЙ ПИТАТЕЛЬ ДЛЯ ПОДАЧИ ХЛОПКА В ПНЕВМОТРАНСПОРТ. *Universum: технические науки*, (9-3 (102)), 11-14.

16. Turgunov, D., No'Monova, R., & Toirov, U. (2022). DISTRIBUTION OF COTTON MASS BY AIR TRANSPORT PIPE LENGTH AND CROSS-SECTION. *Science and innovation*, *1*(D8), 280-285.

17. Sarimsakov Olimjon, S., Sattarov Nurillo, M. U., & Turgunov Dilmurod, U. U. (2022). Theoretical and Practical Examination of the Process of Transfer of Cotton to the Pipes of the Air-Carrying Device. *International Journal of Trend in Scientific Research and Development*, *6*(2), 799-802.

18. Umarali o‘g‘li, T. D., Sharipjanovich, S. O., & Mahmudovich, M. B. (2021). Theoretical research of the effect of damage and air transport working parts on cotton raw materials. *Innovative Technologica: Methodical Research Journal*, *2*(12), 65-76.