ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889, 2023-5.384 ResearchBib IF: 8.848 / 2023

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-2

EFFECT OF CHANGING THE DIAMETER OF THE FAN INLET PIPE ON ITS PARAMETERS

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Abstract. The article examines the influence of the design of the fan inlet pipe on the operating parameters of the fan. The inlet pipe is made in the form of a diffuser, as well as a confuser and different sizes. After alternately installing them on the fan, the fan is started and its main operating parameters are measured with special tools. By comparing the results, the influence of the shape and dimensions of the fan inlet pipe on its parameters was determined. Based on the analysis of the obtained results, rational shape and dimensions of the fan inlet pipe were recommended.

Key words: pneumo-transport, pipe, cotton, fan, aerodynamic force, cyclone, cotton drum, pipe, air consumption.

Introduction. The cotton growing and processing industry is of great importance in the development of the economy of Uzbekistan. In recent years, the cotton ginning enterprises of our republic have been completely reconstructed and modernized on the basis of the state program, and equipping with modern equipment reaches remote areas every day. The purpose of the reforms carried out in the industry in recent years is to improve the quality of products to the level of world market requirements, increase the efficiency of cotton production by reducing its cost.

Product quality and cost are formed at each stage of the technological process of its processing. In this case, an important role is played by the stage of supplying raw materials, which is considered the first link in the process. The supply of raw materials for the cotton processing technology is carried out with the help of pneumatic transport equipment at ginneries. Due to the simplicity of the design of air ducts and the lack of replaceable, controlled parts, their testing is limited to determining the air velocity and pressure in them. Because all other indicators of the pneumatic transport system depend on these two parameters. For example, the productivity of a pipe, or the mass of cotton it can transfer per unit of time (i.e. the capacity of the pipe), depends on the diameter of the pipe, air velocity and pressure. Depending on various factors, the pressure and air velocity in the pneumatic transport system change. However, existing pneumatic equipment does not use air speed and pressure gauges, and air speed and pressure are set approximately. Therefore, it is advisable to install measuring instruments that show the mode of operation of cotton pneumatic transport [1,2].

When a mixture of air and cotton moves in the pipe, various resistances arise, which have a great impact on the performance of pneumatic transport and energy costs. The intake of air from the outside through holes and slots in pipe joints, stone stops and separators seriously affects the performance of pneumatic transport and energy consumption [3]. Our observations show that the intake of air from the outside ("wind loss", in the working language), in existing pneumatic vehicles is very high. This situation leads to excessive consumption of a large amount of electricity and, as

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VOLUME-4, ISSUE-2

a result, to an increase in the cost of the product. Therefore, the problems of ensuring the tightness of the pneumatic transport system, determining and eliminating the causes of air leakage in enterprises are also relevant.

The "heart" of pneumatic conveying equipment, that is, the device that creates movement inside it, is a fan. Therefore, all indicators of the operation of pneumatic transport are related to the parameters of the fan.

Fans are a versatile tool. Except for its special types, there will be no types dedicated to a certain material, such as cotton fan, grain fan. Perhaps, based on the task being performed and the required qualitative and quantitative indicators, fans of a certain type and power are selected for a specific technique. Fig. 1 shows a scheme of a centrifugal fan, one of the most common types of fans in the industry. It mainly consists of a base 1, a casing 2, a fan 3, an outlet pipe 4 and an inlet pipe 5, an electric motor 6, a wheel (pulley) on the fan shaft, a belt drive 7, a bearing 8, a pulley 9 on the motor shaft. When starting the electric motor during operation, its shaft rotates the pulley 9, it rotates the pulley 7, which in turn rotates the fan blade 3.

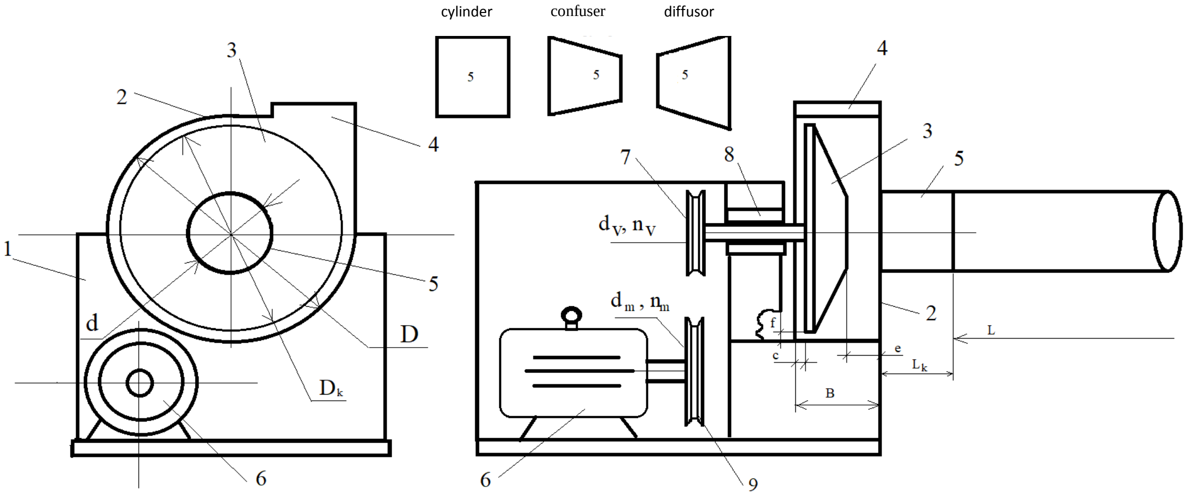

Fig.1. Scheme of a centrifugal fan

As a result of the rotation of the fan blades, air is sucked in through the inlet pipe 5 and ejected through the outlet pipe 4. By connecting pipes of the required length to the inlet and outlet pipes of the fan, it is possible to create an aerodynamic device that sucks air from one place and sprays it to another. If the material is putted into the pipe, the air flow moves it in its own direction and transports it from the suction point to the spray point.

Method. The fan casing (screw), blade, part of the blade rib, blade deflection angle, blade installation method on the propeller are recommended, so the parameters of a fan designed for a certain technology may be incorrect for a different process. Therefore, when choosing a fan for pneumatic conveying equipment designed for a specific product, it is necessary to determine some of its main parameters and check how this parameter is optimal for this process and adjust it. In addition to them, a change in the diameter of the branch pipe at the fan inlet can have a serious impact on its parameters. In these studies, we studied the influence of these factors on fan parameters in order to evaluate the size of the air inlet nozzle and the shape of the short inlet pipe connected to it.

We conducted research at the private enterprise "Ven-kon air engineering", Namangan city, Namangan region. Scientific research was carried out on a high-pressure centrifugal fan. This fan

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VOLUME-4, ISSUE-2

drive has 4 kW power, rotating blades at 3000 rpm and connects to a piping system up to 26 m long. Each pipe is 1.25 m long, which is equal to the width of the steel sheet from which the pipe is made.

The inlet pipe of the used fan has the shape of a cylinder and its diameter is equal to the diameter of the pipe, that is, 14 cm. We prepared a fan pipe in the form of a truncated cone 10x14 cm, 11x14 cm, 16x14 cm, 18x14 cm and 20x14 cm (Fig. 2, 3, 4). These pipes were connected to a pipe with a diameter of 14 cm.

20x14 см 18x14 см 16x14 см

10x14 см 11x14 см

Fig.2. Types of short pipes that connect to the fan inlet nozzle.

a) b)

Fig.3. Overview of the experimental pneumatic device. a) fan inlet pipe b) assemblied pneumatic device

By connecting them to the pipe in turn, a 26 m long track was formed from the pipes (Fig. 4). The velocity, static and dynamic pressures of the suctioned air in the pipe were measured using special measuring devices: anemometer and micromanometer. The device was connected to a 380 V current source through an inverter device, and the current and voltage changes were monitored.

Results. According to the Table 1, the diameter of the fan inlet is 10 cm, and when a diffuser with a length of 20 cm is connected to it, a full pressure of 5400 Pa occurs with the pipe

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VOLUME-4, ISSUE-2

inlet closed, and when the pipe inlet is open, a static pressure of 2500 Pa and a dynamic pressure of 1380 Pa occurs at a distance of 0.20 m. Air speed is 48 m/s. As the length of the pipe increases, the air pressure and velocity at the beginning of the pipe decrease, and at a distance of 26 m, the static pressure is 900 Pa, the dynamic pressure is 1160 Pa, and the air velocity is 44 m/s. In order not to increase the size of the article, we did not present the results of subsequent studies in tabular form. However, we will present the analysis.

The results of the measurements taken on the manufactured 10x14 cm diffuser tube.

Table 1.

№	Fan state		Amperage (A)	Voltage (B)	Power (W)	Frequency (Hz)	Static pressure (Pa)	Dynamic pressure (Pa)	Velocity m/s
Manufactured 10x14 cm diffuser tube									
1	Closed inlet nozzle (0,20 м)		2,6-3	380	1,7	50	5400		
2	Tube length 26,05м	0,20 m From inlet nozzle	7,5	380	4,24	50	2500	1380	48
		6,70 m From inlet nozzle	7,5	380	4,24	50	2060	1320	47
		25,60 m From inlet nozzle	7,5	380	4,24	50	900	1160	44

The diameter of the fan inlet is 11 cm, and when a diffuser with a length of 20 cm is connected to it, a full pressure of 5350 Pa with the inlet of the pipe is closed, and when the inlet of the pipe is opened, a static pressure of 3240 Pa and a dynamic pressure of 1880 Pa was created at a distance of 0.20 m. Air speed was 56 m/s. As the length of the pipe increased, the air pressure and velocity decreased at the beginning of the pipe, and at a distance of 26 m, the static pressure was 1180 Pa, the dynamic pressure was 1620 Pa, and the air velocity was 52 m/s.

The diameter of the fan inlet is 14 cm, and when a cylinder with a length of 20 cm is connected to it, a full pressure of 5250 Pa with the pipe inlet closed, and a static pressure of 3350 Pa and a dynamic pressure of 1880 Pa at a distance of 0.20 m, when the pipe inlet is opened. Air speed is 56 m/s. As the length of the pipe increased, the air pressure and velocity decreased at the beginning of the pipe, and at a distance of 26 m, the static pressure was 1280 Pa, the dynamic pressure was 1620 Pa, and the air velocity was 52 m/s.

The diameter of the fan inlet is 16 cm, and when a 20 cm long confusor is connected to it, a full pressure of 5350 Pa with the pipe inlet closed, and a static pressure of 3850 Pa and a dynamic pressure of 2160 Pa at a distance of 0.20 m, when the pipe inlet is open. The air speed was 60 m/s. As the length of the pipe increased, the air pressure and velocity decreased at the beginning of the pipe, and at a distance of 26 m, the static pressure was 1350 Pa, the dynamic pressure was 1880 Pa, and the air velocity was 56 m/s.

The diameter of the fan inlet is 18 cm, and when a 20 cm long confusor is connected to it, a full pressure of 5350 Pa was created with the pipe inlet closed, and when the pipe inlet was opened, a static pressure of 3800 Pa and a dynamic pressure of 2080 Pa occurred at a distance of 0.20 m. Air speed was 59 m/s. As the length of the pipe increased, the air pressure and velocity decreased at the beginning of the pipe, and at a distance of 26 m, the static pressure was 1350 Pa, the dynamic pressure was 1880 Pa, and the air velocity was 56 m/s.

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THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

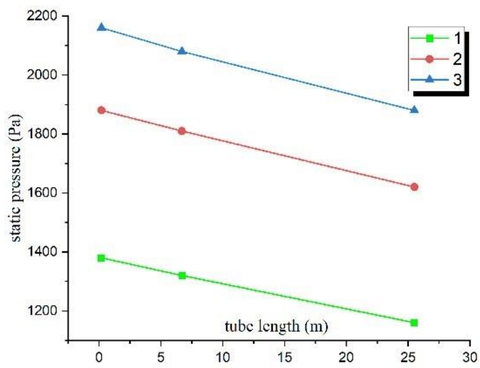
VOLUME-4, ISSUE-2

beginning of the pipe, and at a distance of 26 m, the static pressure was 1340 Pa, the dynamic pressure was 1810 Pa, and the air velocity was 55 m/s.

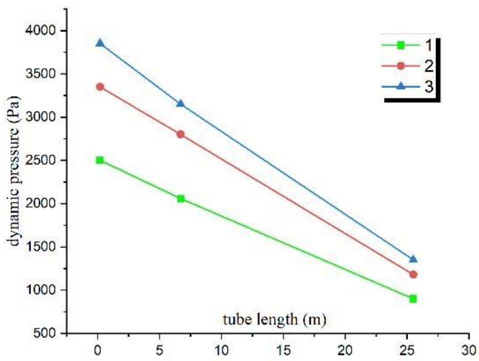
The diameter of the fan inlet is 20 cm, and when a 20 cm long confusor is connected to it, a full pressure of 5250 Pa occurs when the pipe inlet is closed, and when the pipe inlet is open, a static pressure of 3770 Pa and a dynamic pressure of 2080 Pa occurs at a distance of 0.20 m. Air speed was 59 m/s. As the length of the pipe increased, the air pressure and velocity decreased at the beginning of the pipe, and at a distance of 26 m, the static pressure is 1330 Pa, the dynamic pressure is 1810 Pa, and the air velocity is 55 m/s.

The graphs of the variation of the air velocity, static and dynamic presure in the pipe along the length of the pipe when the fan pipe diameters are 10 cm, 14 cm, and 16 cm are presented in Fig. 4.

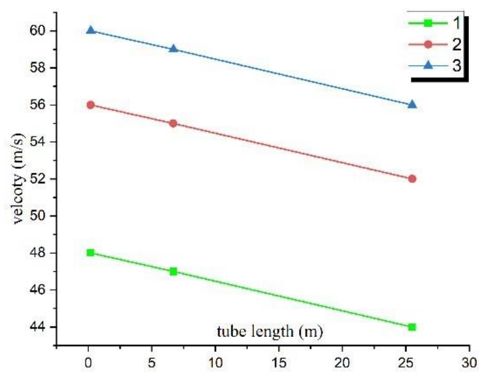
According to them, the air velocity along the length of the pipe decreases linearly with the dynamic and static pressure in front of the fan towards the pipe head. In this case, the intensity of the decrease in speed is relatively low, around 7%, that of dynamic pressure is around 18%, and that of static pressure is quite high - around 65%. This law was also confirmed in all the experiments conducted.



a)



b)



c)

Fig. 4. Variation of the a) static, b) dynamic pressure and c) air velocity in the pipe along the length of the pipe (fan pipe diameters 1-10 sm, 2-14 sm, 3-16 sm).

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VOLUME-4, ISSUE-2

The results show that, with the increase in the diameter of the fan inlet nozzle, the air pressure and speed increase, and this law continues until the pipe inlet is 16 cm. When the diameter goes from 16 to 18 cm and from 18 to 20 cm, the pressure and speed decrease compared to the final result. Accordingly, it can be said that it is appropriate to prepare the diameter of the inlet nozzle of the fan with actual dimensions of 16 cm. However, this size depends on the diameter of the fan shell. What is the ratio for other sizes? To answer this question, we introduce a coefficient that represents the ratio of the diameters of the case and the inlet hole:

$$Kt = d / D, \quad (1)$$

According to the dimensions used:

$$Kt = d / D = 16 / 80 = 0.2$$

As a result, the diameter of the inlet hole for other diameters of the fan case can be found from the following equation:

$$d = D \cdot Kt, \quad (2)$$

The diameter of the inlet pipe at the connection to the fan is equal to the diameter of the hole in the case *d*. However, the shape of this pipe and the size of the three parts depend on the diameter of the main pipe connected to the pipe, which should be determined experimentally.

Conclusions. Centrifugal and radial fans, among other parameters, depend on the diameter of the fan inlet, the shape and size of the inlet pipe.

When the fans work, the speed and pressure of the air flow it generates decreases linearly from the fan to the end of the pipe, and the change intensity of the air speed and dynamic pressure is relatively low, but the static pressure is very high.

As a result of the conducted research, it was determined that the coefficient of the ratio of the diameter of the fan inlet and the diameter of the fan screw should be around 0.2. However, the shape and size of the fan inlet pipe depends on the diameter of the main pipe connecting to the pipe, which should be determined experimentally.

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