The American Journal of Engineering and Technology
(ISSN – 2689-0984
Published: March 27, 2021 | **Pages:** 58-64
Doi: https://doi.org/10.37547/tajet/Volume03Issue03-09

IMPACT FACTOR
2021: 5. 705
OCLC - 1121105677

Determination Of Parameters Of The Separating Pipe Pneumatic Conveying System Cotton Pickers

Sattar Ramazanovich Alikulov
Doctor Of Technical Sciences, Professor, Department Of Agricultural Mechanization And Service, Karshi Engineering And Economic Institute, Karshi, Uzbekistan

ABSTRACT

Analytical and experimental studies have determined the rational design and aerodynamic parameters of the separating pipeline for the delivery of raw cotton from the harvesting machines to the hopper of the machine. A laboratory setup and methodology for conducting laboratory tests have been developed.

KEYWORDS

Pneumatic transport, fan, absorbing, discharge pipelines, air stream, distribution, air stream speed, rounding radii, filming.

INTRODUCTION

To conduct experimental studies on determining the aerodynamic parameters of the pneumatic transport system of a cotton harvester, to study the process of moving raw cotton through a curved separating pipeline, as well as to justify the main parameters of the pneumatic transport system, a laboratory stand was made (fig.1).

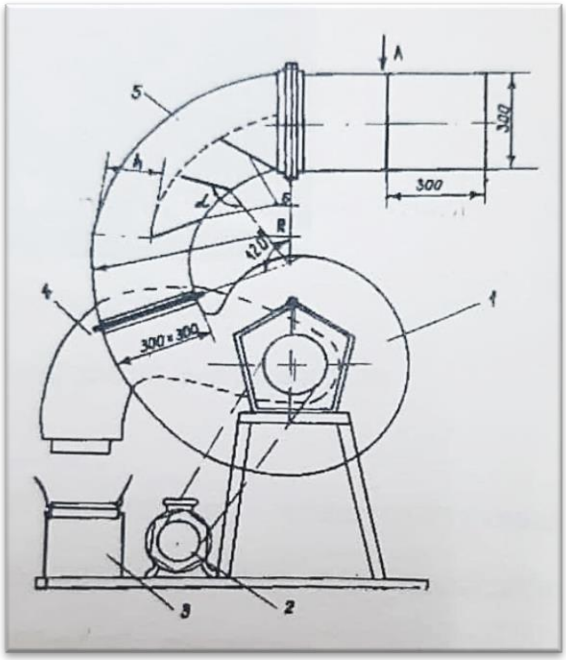


Fig.1. Laboratory installation for studying the process of raw cotton transportation with air stream separation

1-cotton harvesting machine fan; 2-electric motor; 3-belting; 4-absorbing pipeline; 5-discharge pipeline.

The stand consists of a fan 1 from the cotton harvester, set on a special frame. The fan wheel is driven by a belt drive from an electric motor 2. A transporter 3 is installed under the absorbing pipe for steady supply of raw cotton to the fan.

By way of the maximizing the work approach of the bench fan to the operating conditions of the pneumatic transport system of the cotton harvester, the speed of the fan wheel on the stand corresponds to the speed of the fan wheel on the cotton harvester in the operating mode is 144.4-146.5 s^{-1} . To create a certain aerodynamic resistance, flaps are installed at the fan inlet in front of the absorbing pipe, which partially block the inlet openings. Thus, the section of the entrance is selected, which corresponds to the aerodynamic resistance of the receiving chambers of the cleaning machines and the pipelines of the cotton harvesting machine.

THE MAIN FINDINGS AND RESULTS

As already mentioned, the raw cotton is fed to the absorbing pipe of the fan is performed with the help of transporter. The productivity of a cotton field is imitated by the amount of raw cotton evenly spread out on one running meter of the transporter. The speed of the transporter belt is 1m/s. To simulate a double-row cotton harvester operating in a field with a productivity of 35 c / ha (0.35 kg / m^2), it is necessary to lay 0.5 kg of raw cotton on 1 meter of the transporter.

For the experiments, variants of the studying pipelines with radii of rounding along the outer wall of 0.65 m, 0.80 m and 0.95 m were made. The choice of separating pipelines within these limits is explained by the fact that at R 1.0 m, the dimensions of the pneumatic transport system are significant, and at R 0.6 m, the separating ability of the pipeline gets worse. The dimensions of the cross sections of the inlet and outlet openings of the pipelines are constant and equal, accordingly, 0.3 x 0.3 m2 and 0.5 x 0.3 m2. The angle of rotation of the pipeline relative to the horizontal at 1200 is caused by the constructive features of the fan. The side walls of the pipeline for high-speed filming are made of transparent Plexiglass. The outer wall of the pipeline is removable, made of metal mesh fabric 2a-50x32x1. 0 [ ].

Preliminary experiments have shown that the cloths used in the separating devices of the covers of the bins of cotton harvesters have the best separating ability and work without the slaughters. In this regard, all further studies were carried out with pipelines, the outer wall of which is made of this mesh fabric with rectangular holes.

At the laboratory stand, the parameters of pipelines that affect the separation of the air flow during the transportation of raw cotton in it were studied. These include the radius of the pipeline, the height of the cross-section for the passage of air, the nature of the distribution of the air flow and its aerodynamic parameters in the separating pipeline. The characteristics of the distribution of air stream speed along the length and width of the separating pipeline was determined on the stand in the laboratory and directly in the pipelines in the field installation by measuring the dynamic pressure of the air stream. The pressure was measured using a Pitot-Prandtl tube and an MMN micrometer.

The studied cross-section was divided into steady sections. Having determined the quantity of the dynamic pressure in the center of each of them, the average dynamic pressure, velocity, and flow rate of the air flow were calculated and the field of air stream velocities in this section was constructed. The average dynamic pressure is defined as

$$P_0 = \frac{\sum_{i=1}^{z} \sqrt{P_{di}}}{Z}, \qquad (1)$$

where P_{di} – dynamic (speed) pressure at certain points, kg / m^2,

Z – number of measurement points.

The air velocity was determined from the found values of the dynamic pressure

$$V_B = \sqrt{\frac{2g}{\rho}} P_0, \qquad (2)$$

Published: March 27, 2021 | **Pages:** 58-64
Doi: https://doi.org/10.37547/tajet/Volume03Issue03-09

IMPACT FACTOR
2021: 5. 705
OCLC - 1121105677

where g – acceleration of gravity, m / s², by

$$\rho = \rho_0 \frac{T_0 \mathrm{P}}{T P_0}, \qquad (3)$$

where $\rho_0 = 1.2\ ^{\mathrm{kg}}/_{\mathrm{m}^3}$, by T_o =293° K and P_0=10330 kg / m².

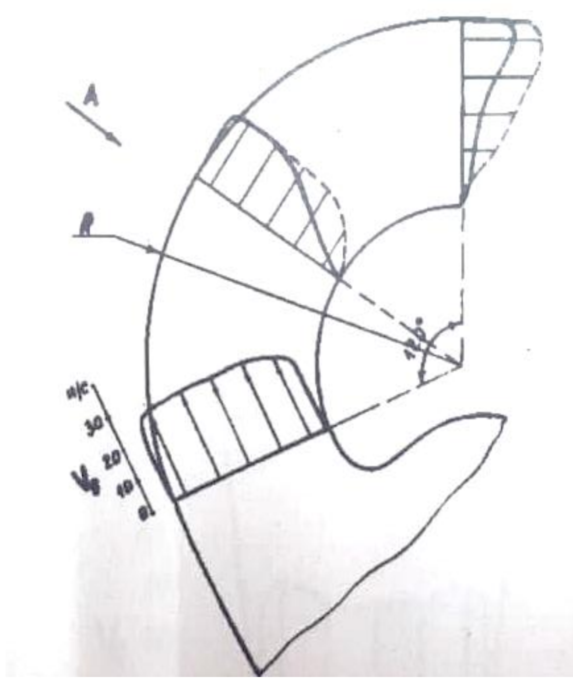
The air flow rate in the measured section is defined as

$$Q = S_T V_B, \qquad (4)$$

where S_T – the cross-sectional area of pipe, m².

Figure 2 shows the distribution of air stream speed in a separating pipeline in cross sections and, for comparison – the distribution in a pipeline with a solid outer wall. As follows from the picture, the air stream speed at the fan outlet (at the inlet to the pipeline) is evenly distributed along the height and reaches 28 – 29 m/s.

Moving through the pipeline, there is a redistribution of speeds – at the outer wall, the speed of the air flow is greater than at the inner wall. For this reason, the speed of the air stream along the outer wall of the pipeline, despite the separation of part of the transported air, changes slightly, which justifies our assumptions made in analytical studies.



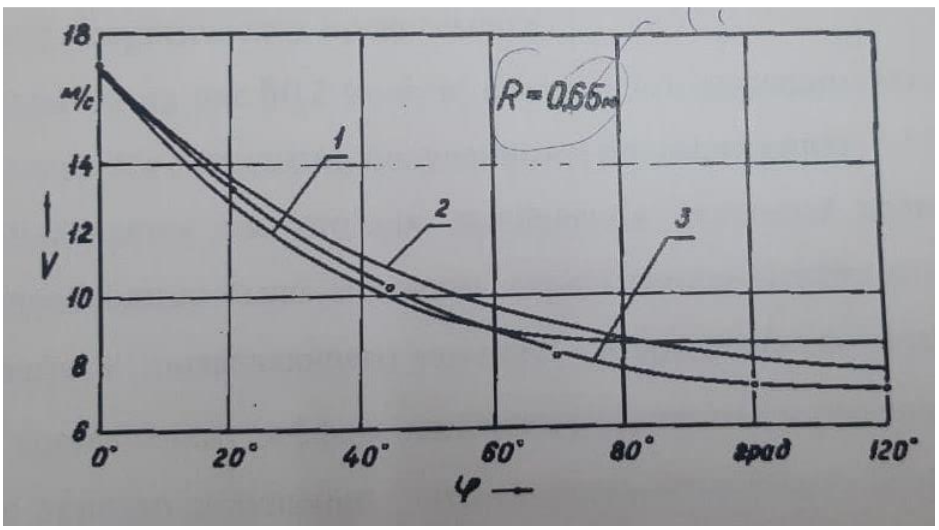
_____ the outer wall is mesh

------- the outer wall is entire

Fig.2. Distribution of air stream speed in the separating pipeline (*R*=0.8 m).

To determine the trajectory of the movement slices at the entrance to the separating pipeline, the speed and thickness of the layer that moves the raw cotton in it, high-speed filming was carried out with a SKS-1 movie camera. The shooting frequency was 950-1000 frames per second. For the processing of kinograms, the "Microphoto" device and the "Kupava-16" device were used, produced for visual viewing of the process captured on film. As the film footage showed, the cotton flies out of the fan mostly at the outside of the exit window, which is explained by the presence of centrifugal forces. But there are individual slices and lumps of raw cotton flying out of the fan closer to the inside of the exit window. The analysis and calculations carried out on the kinograms show that the initial speed of cotton movement through the separating pipeline varies from 16 m/s to 18 m/s.

The differential equation of motion of a cotton slice on a curved mesh surface was solved analytically and experimentally, the results of which are shown in fig. 3.



1-according to the solution of the equation on a computer; 2 - according to the analytical solution; 3 - according to the experiments.

Fig. 3. Changing of the speed of movement of a cotton slice in the separating pipeline.

The degree of correspondence of the functions obtained on a computer was evaluated analytically and experimentally using the Kolmogorov criterion [ ]. To clarify the theoretical functions when composing a differential equation and solving it on a computer, we assumed that the air stream speed is constant, although in reality this is not the case. And therefore, the steady-state speed of the cotton slice obtained on the computer turned out to be slightly higher than that obtained in experiments.

Experiments to determine the rational parameters of the separation pipeline were carried out on a laboratory installation. The feed of raw cotton to the fan was 0.5 kg/s, which corresponds to the operation of a double-row cotton harvester at the first harvest, in a field with a productivity of 30-35 c/ ha. At a certain height of the cross section h for the passage of air, a portion of raw cotton is transported through the separating pipeline to the hopper (container), after which the cotton that has flown out of the pipeline is collected. Cotton losses were estimated by the coefficient q. At the same time, the air flow velocity at the outlet of the separating pipeline is determined, the flow rate is calculated, and the separation coefficient is calculated ϑ.

CONCLUSION

According to the results of the experiments, from the point of view of maximum separation and elimination of losses, the minimum cross-section height for the passage of the transported raw cotton should be in the range of 165-175 mm, depending on the radius of curvature of the pipeline. Analyzing the experimental data, it can be noted that pipelines with rounding radii of R= 0.95 m and R=0.8 m are close to each other in their separating qualities and more effectively separate the air flow compared to a pipeline with R=0.65 m. However, from the point of view of dimensions and metal consumption, the use of a separating pipeline with a radius of R=0.8 m is more appropriate than a pipeline with R=0.95 m.

REFERENCES

1. Alikulov S.R., Achildiev Sh. Technology and means of mechanization of farmers producing cotton in the composition of cluster system cooperatives. Science and Education, No.23 (101), Part. 2, 2020, P. 16-20.
2. Alikulov S. R., Eshkabilov O.Kh. Research of the cotton sealing process in facilities of a frame-type. Journal of Critical Reviews. No. 103, Section, Roosevelt Rd, Da`an District, Taipei City, Taiwan, 25.06.2020. P. 1831- 1840…
3. Alikulov S.R. The process of compaction of cotton mass in constant width volumes. // Innovative technologies, Karshi, 2013, №2 (10), P.37-38.
4. Alikulov S.R. The scientific basis for the development of models and methods for calculating the process of cotton compaction in machines for the formation and transportation of compacted cotton modules. Thesis Doct. tech. Sciences, Tashkent: 2007. P. 305.
5. Alikulov S.R. Compaction of cotton in bunkers of cotton pickers and bodies of vehicles, Karshi, 2007, –196 p.
6. Alikulov S.R., Djurayev A. Research in compaction of cotton under its pulsed unloading in container trailers and modules of system "Multilift". // Proceedings of universities. Engineering, No. 2-4, Tashkent, 2001. P.55-58.
7. Mardonov B.M., Khodzhiev M.T., Muborakov A.Ya. On the compression of a nonlinear elastic-plastic material in a limited volume // Dokl. AN RUz, 1997. №6. –P.21-23.
8. Alikulov S.R., Rashidov N., Khudoiberdiev A.A. Layer-by-layer raw cotton compactor. // Technics in agriculture. 1989. No.1. P.16.
9. Copyright certificates 1532434. Cotton sealant. Rashidov N., Alikulov S.R., Khudoiberdiev A.A., Kim E.G., Ashiraliev

M., Malkov S.V., Tulepov U.B. Publ. in B.I. 1989. No.4.

10. Copyright certificates 1115968. Compactor of cotton in the container of a cotton picker. Rashidov N., Alikulov S.R. and others. Publ. in B.I. 1984. No.36.
11. Bronshtein I.I., Semendyaev K.A.. Math reference. M .: Nauka. 1986. P. 544.
12. Korn G., Korn T. Handbook of mathematics for scientists and engineers. M .: Nauka, 1978. P. 892.