ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 9 , September 2020

Determination of Oscillation Amplitude of Cotton Particle at Interaction with Plate and Shock Absorber of the Separator

DjuraevAnvarDjuraevich; DavidbayevBahtiyordjonNizomitdinovich; DavidbaevaNargizakhonBakhtiyerdjanovna

Doctor of Technical Sciences, Professor, Department of machine science and service, Tashkent Institute of Textile and Light Industry, Uzbekistan
Candidate of Technical Sciences, Professor, Department of Applied Mechanics, Fergana Polytechnic Institute, Uzbekistan
Assistant, Department of Applied Mechanics, Fergana Polytechnic Institute, Uzbekistan.

ABSTRACT: The scheme and the principles of operation of the separator shock-absorbing plates are provided in the article. Results of the decision a problem of fluctuations of a plate with a cotton particle are given. The formula for calculations of the amplitude of fluctuations of a particle of cotton with a plate is presented. On the basis of the analysis of the constructed graphic dependencies, parameters of a plate of the shock-absorbing basis are proved.

KEYWORDS: separator, raw cotton, rubber shock absorber, vibrations, stiffness, dissipation perturbation, friction, drop, mass, damage, seed, litter, effect, process, equations, plate, face, mass, particle.

I. INTRODUCTION

The known structure of the separator CC-15A contains a separation chamber, a vacuum valve, a perforated mesh and a scraper shaft [1] The drawback of this design is the insufficient separation of raw cotton from the air, as well as high wear and reduced service life of the chamber due to the impact interaction of raw cotton with especially large weeds (stone and other heavy impurities) against the chamber walls. At the same time, the wall heats up, its deformation occurs, and cracks can also occur, which leads to a sharp decrease in pressure in the chamber. To increase the efficiency of separation of fibrous material from airflow at different ratios of concentration of mixture - fibre and airflow, as well as to reduce wear, elimination of deformations and friction of opposite wall from the zone of air supply with cotton.

II. MATERIALS AND METHODS

The design of the separator for fibrous materials has been improved by automatically adapting and ensuring the necessary removal and dropping of raw cotton from the mesh, as well as cushioning the impact of cotton and heavy solids with the opposite wall from the cotton supply zone into the chamber. Separator for fibrous materials comprises separation chamber 1, vacuum valve 2, perforated net 3, scraper shaft 4 composed of shaft 4 and outer bushings 11 with scraper blades 12 arranged thereon by means of elastic (rubber) bushings 9. Damping plate 6 is installed on opposite wall 8 of separation chamber 1 by means of rubber gasket 7.
The plate is fixed to the rear wall of the separator using a frame with screw 9. (Fig. 1).

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 9 , September 2020

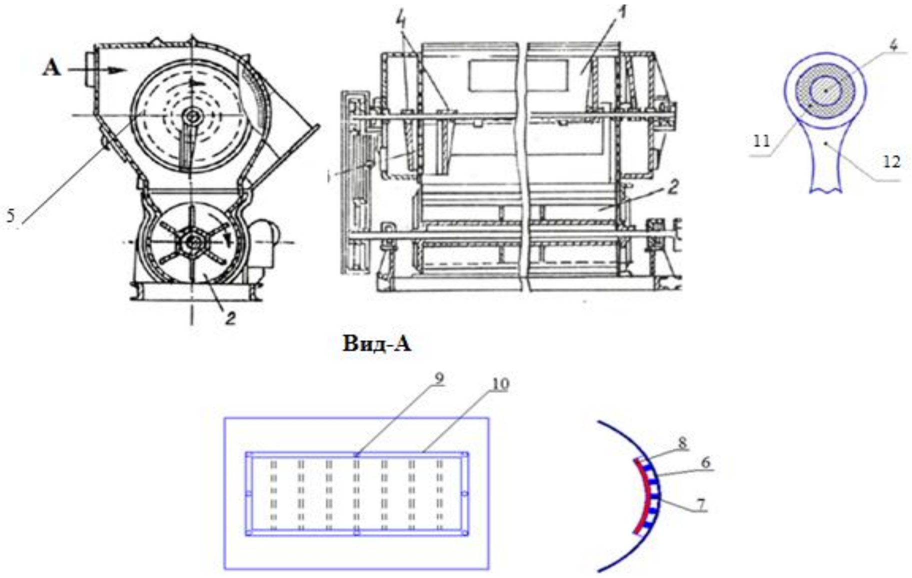


Figure 1. Schematic of a Modernized Fiber Separator Design.

The separator for fibrous materials works as follows. The raw cotton, together with the air transporting it, enters through the suction pipeline into the separation chamber 1, slides along its surface, is fed into the vacuum valve 2 and is discharged from the separator by its impeller. Separate raw cotton volatiles, adhering to the perforated grids 3 of the separation chamber 1, is cleaned from them by scrapers 12 of the shaft 4 and are also discharged into the vacuum valve 2. When raw cotton enters the separation chamber 1 under pressure at a high speed, heavy coarse impurities together with cotton hit the surface of plate 8 and are absorbed by deformation by an elastic (rubber) gasket 7. This significantly reduces the damage to the plate 8, as well as the corresponding part of the scraper shaft 4. The elastic sleeve 11 of the composite scraper shaft 4 provides effective cleaning of the perforated nets 3 from cotton due to additional vibrations of the outer sleeve with blades 11. It should be noted that the elastic (rubber) bushings 11 reduce the load on the shaft 4 and thus on the bearing supports arising from the unbalanced inertial forces of the outer bushings with blades 11. To reduce damage to the fibres and cotton seeds, as well as to increase the service life of the separator, it is important to determine the force of interaction of the cotton parts with the reflector surface [1]. In fig. 2.shows a diagram of the interaction of a cotton particle in the form of a concentrated mass on the surface of a reflector with a rubber shock absorber in the process of separation. In this case, the perturbing force of the raw cotton particle mainly depends on the rate of entry and the mass of the cotton particle:

$$P(t) = F_0 \sin \omega t \quad (1)$$

where, F_0 is the amplitude value of the impact force of the cotton particle, is the frequency of the disturbing force change.

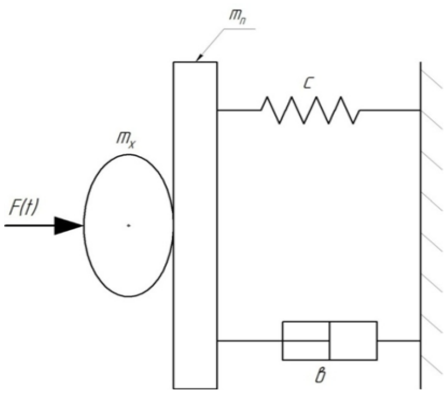


Figure 2.Diagram of the interaction of cotton particle against the surface of the reflector with rubber shock absorber.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 9 , September 2020

During operation of the separator, raw cotton with a certain force hits the surface of the separator reflector, vibrations of the plate with mass mn occur. due to elasticity of rubber shock absorber. Accordingly, the mass m_x of raw cotton fluctuates. These oscillations mainly depend on the force of interaction of the raw cotton particle with the surface of the reflector. In this case, the particle of raw cotton with mass m_x fluctuates cyclically during its interaction with platinum m_x. Then, using the Dalamber principle [2,3], we can derive the equation of the oscillatory motion of the cotton particle and the reflector plate:

$$\begin{aligned} &m_x \ddot{X}_1 + F_0 \sin \omega t = 0 \\ &m_n \ddot{X}_2 + b \dot{X}_2 + C = R \end{aligned} \qquad (2)$$

where R is the reaction force, X_1, X_2 are the movement of cotton particles and the reflector plate. mx, mn are the masses of the cotton particle and the plate. *b, c,* - coefficients of dissipation and stiffness of the rubber damper of the reflector.

Analysis of the obtained system of equations (2) shows that m_x and m_n can independently oscillate only when a cotton particle bounces off the reflector surface. But, given the physical and mechanical peculiarity of cotton, the cotton particle does not actually bounce off the surface of the reflector and therefore they will vibrate together, that is, $X_1 = X_2$, then

$$\ddot{X}(m_x + m_n) + bX + \mathbf{CX} = \mathbf{R} \sin \omega t \qquad (3)$$

Reducing equation (3) into the standard one [4,5], we have:

$$2n = \frac{b}{m_x + m_n};\ P_0^2 = \frac{C}{m_x + m_n};\ R_1 = \frac{R_0}{m_n + m_0} \qquad (4)$$

Using the reduction technique in [5, 6], we obtain a solution to equation (3) for the steady-state operation of the system:

$$X = \frac{R_1 \sin(\omega t - \beta)}{\sqrt{-\omega^2)^2 + 4n^2 * \omega^2}};\mathrm{tq}\ \beta = \frac{2n\omega}{P_0^2 - \omega^2} \qquad (5)$$

Angleβ characterizes the phase shift between the displacement of the system at steady-state oscillations and the disturbing force. In this case, according to (5), the vibration amplitude of the cotton particle and the plate is determined from the expression:

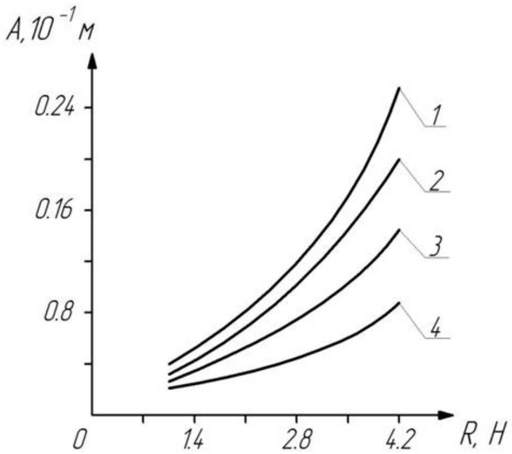
$$A_x = \frac{R_0}{\sqrt{\left(P_0^2 - \omega^2\right)^2 + 4n^2 10^2}} \qquad (6)$$

During the operation of the separator, the raw cotton particle hits the plate with the shock absorber and then they oscillate together along the horizontal axis. The amplitude of these oscillations depends on the weight of the cotton, elastically dissipative properties of the shock absorber. Consider the effect of these parameters on the amplitude of oscillations. In Fig. 3.there are presented the constructed dependencies of change of amplitude of mass oscillations (m_x+m_n) on the disturbing force, that is, on the impact force of cotton, which drives airflow.

III. RESULTS

Analysis of graphs shows that with an increase of force R, from 0.8 H to 4.22 H amplitude of oscillations of total mass (m_x+m_n) increases from 0,35*10^3м to 2,4*10^{-3}м at ($m_x + m_n$)= 0,8 *10^{-2}kg. As the total mass increases, the amplitude of its oscillation will increase with lower intensity. So at (m_x+m_n))= 2,8 *10^{-2}kg the amplitude increases from 0,17*10^{-3} m to 1.16*10^2 m. At the same time, timely dropping down of raw cotton particles after its interaction with the reflector is important. Therefore, the greater the amplitude of the A_x oscillation, the faster the cotton particles are released from the reflector plate. In this regard, the most acceptable values of the perturbing force are $R_0 \geq$

$(2{,}8 \div 4{,}2) * 10^{-3} n.$

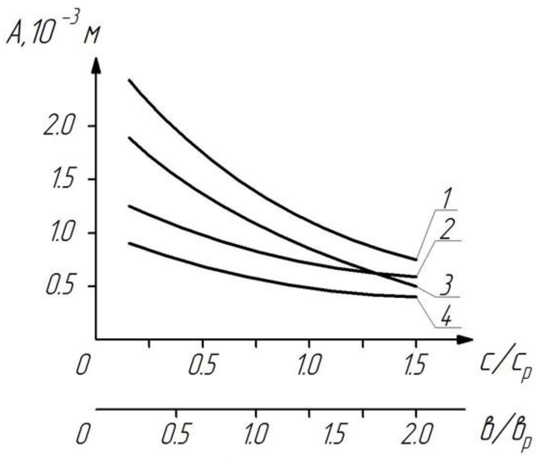


1- at $(m_x + m_n)$= 0,08*10^{-1} kg, 2- at $(m_x + m_n)$= 0,15*10^{-1} kg, 3- at $(m_x + m_n)$=0,22*10^{-1} kg, 4- at $(m_x + m_n)$= 2.8*10^{-2} kg.

Figure 3. Graphic dependencies change of amplitude of total mass oscillations (m_x+m_n) from perturbing force.

Figure 4 shows the graphical dependences of the change in A_x on the increase in the elastic-dissipative parameters of the shock absorber.

So, at (m_x + m_n) = 0.12 kg, the amplitude of its fluctuations with an increase in c/c_pот 0,21 to 1.5 A_x decreases from 2,34. 10^{-3} m to 0,52 10^{-3} m, and an increase in mass (m_x + m_n) to 2,6*10^{-2} kg, the vibration amplitude decreases to 0,47*10^{-3} m.



1,3 – at $(m_x + m_n)$ =(0,08÷ 0,12) $* \ 10^{-1} kg$; 2,4- at $(m_x + m_n)$=(0,15÷ 0,26) $* \ 10^{-1} kg$;
1,2- A_x=f(c/c_p); 3,4A_x =f(b/b_p)

Fig. 4. Graphical dependencies of change of amplitude of total mass oscillations (m_x + m_n) on change of stiffness coefficients and dissipation of reflector shock absorber.

IV. CONCLUSION

For the recommended values of elastic and dissipative parameters of the reflector shock absorber, the grade of rubber 1338 corresponds. To reduce the mass of the reflector plate, it is made of several parts of rectangular plates. Cotton separator with reflector with rubber shock absorber is recommended. Fluctuations of the total weight of cotton particles from the plastic shock absorber were studied.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 9 , September 2020

REFERENCES

[1] Djuraev, B. N. Davidboev, N. B. Davidboeva. "Development of effective design and test results of a raw cotton separator".Fergana. Vol: 4, 2019. Actual problems of the introduction of innovative techniques and technologies at enterprises for the production of materials, the chemical industry and related industries, Collection of materials of the international scientific and technical conference p.p. 282-284.

[2] L. G. Loitsyansky, A. I. Lurie. (1995). The course of theoretical mechanics, ed. *State tech. Moscow*, p. 596.

[3] Juraev, D. Mamatova. (2019). Development of design schemes and methods for calculating belt drives with variable parameters. *Ed., "Fan vatexnologiya", Tashkent*, p. 230.

[4] Svetlitsky, V. A., &Stasenko, I. V. (1973). Collection of problems on the theory of vibrations: A textbook. *Higher school*. p. 456.

[5] Juraev et al. (2013). Dynamics of vibrating working organs of raw cotton cleaners. "*Fan" publishing house, Tashkent*, p. 192.

[6] Dzhuraev., O. I. Razhabov., M. I. Amanov. (2010). Improvement of technology of construction of working bodies of the cotton cleaner from small litter. Ed. "Fanvatexnologiya", p. 192.

[7] Djuraev, A. "Design development and methods for calculating the parameters of prickly meshes". Monograph LAPLAMBERT Academic Publishing, 2016, p. 158.

[8] DjuraevAnvar, KulievTokhirMamarajapovich. "Designing and Methods of Calculating Parameters of a Fibrous Material Cleaner From Large Litter". *International Journal of Advanced Science and Technology*, Vol. 29, no. 8s, Apr. 2020, pp. 444-52, http://sersc.org/journals/index.php/IJAST/article/view/10530.

[9] DjuraevAnvar, KulievTokhirMamarajapovich. "Improvement of the Construction and Justification of Parameters of the Fibrous Material Regenerator". *International Journal of Advanced Science and Technology*, Vol. 29, no. 8s, Apr. 2020, pp. 453-60, http://sersc.org/journals/index.php/IJAST/article/view/10533.

[10] AnvarDjuraev, TokhirKuliev. "Creation of a Design and Justification of Parameters of a Single-Stage FiberCleaner ". *International Journal of Advanced Science and Technology*, Vol. 29, no. 05, May 2020, pp. 4522-4529, http://sersc.org/journals/index.php/IJAST/article/view/13783.