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Analysis of Random Forces Acting on a Porous Surface by Cotton Raw Materials

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Annotation: In order to increase the cleaning efficiency of the machine in the equipment for cleaning seeded cotton from small impurities, a blind surface is proposed instead of a mesh surface. When choosing the technological parameters of cleaning cotton from small impurities, the main control developments and calculation processes were considered.

Keywords: cotton, technology, dirt, theory, equation, blind surface, power, virginity, support.

INTRODUCTION

Analysis of the vibration of the louver surface of the cleaner under random forces from the cotton suggested that the support of the louver surface activating the louver surfaces causes additional shaking of the cotton and increased release of mainly small-sized weed mixtures. In order to ensure the desired cleaning effect, it is desirable to justify the parameters of the geometrical and support uniformity of the blind surface.

The main part

A random perturbing force acts on a single-mass vibrating system. According to the pre-damped technique, the differential equation describing the vibrations of the blind surface under random disturbance, taking into account the elastic properties of the blind surface, has a single-mass vibration system:

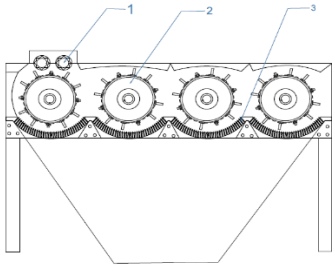

Figure 1. General view of the blind surface in the new construction. Technological resistance during its cleaning from cotton has a random character, which was determined experimentally. The obtained experimental data were processed by the method of mathematical statistics, the parameters of the mathematical expectation and the random component were determined.

Numerical solution of the differential equation by analytical methods presents a certain difficulty. The problem was solved numerically on a computer using standard programs with calculated values of the following parameters: $m_n = 3{,}1 \cdot 10^{-2}$ кг; $M(Q) = 1{,}2$ Н; $c = 1{,}4 \cdot 10^{3}$ Н/м; $b = 12{,}5$ Нс/м; $\delta Q = (20 \div 25)\%$ от $M(Q)$.

An algorithm was created for computer implementation in determining the nature of the vibrations of the shutter surface during cotton cleaning, which included taking into account the random components of the disturbing force of cotton in the form of a random number generator. Taking into account that the pile drum rotates 8 times per second and the number of pile rows is 18, the amplitude of the random component for the random number generator was chosen to be 1.55 H, and with its change to 8.0 H, the frequency 64 c^{-1}[1] and the frequency of natural oscillations increased. According to the results of the implementation of the mathematical model of the vibration of the blind surface on a computer with the necessary changes of parameters, the corresponding graphic relationships are obtained.

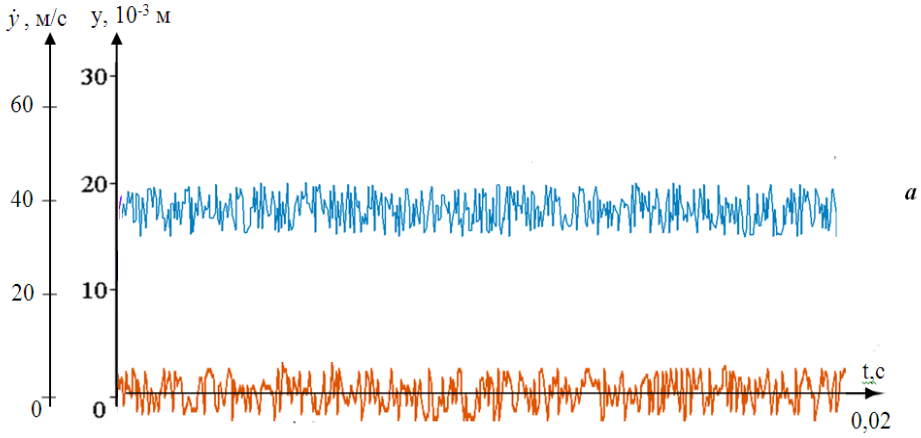

Fig. 2 shows the patterns of vibration of the louvered surface of the cleaner under the random influence of cotton.

With the average value of the cotton distortion, the average value of the shutter surface movement reaches $1{,}82 \cdot 10^{-3}$ m, and the amplitude of the shutter surface vibrations reaches $(0{,}42 - 0{,}85) \cdot 10^{-3}$ m.

At the same time, the speed of the blind surface reaches m\s. An increase in the load from cotton significantly increases the vibration amplitude of the blind surface.

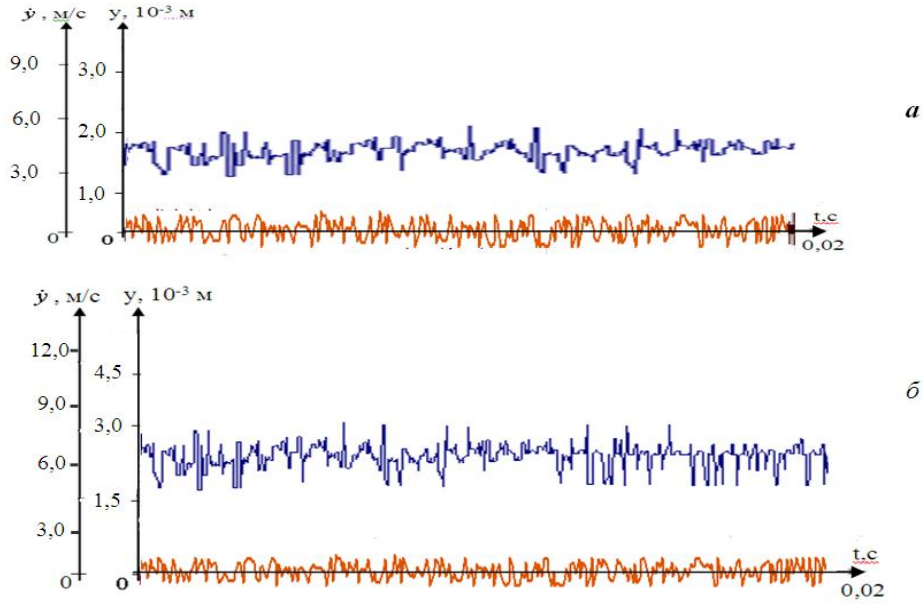

Figure 3. Plot of average value of louvered surface motion with perturbing force and random component.

The average value of the plate movement with the disturbing force 1,5 H and the random component $0{,}14 - 0{,}16$ n reaches $2{,}83 \cdot 10^{-3}$ m, while the oscillation of the louvered surface reaches $2{,}45 - 2{,}82$ m/s values.[2] Graphs of displacement and velocity of the cleaning louver surface are constructed as the cotton tension increases.

When the load is 1.2H and the mass of the blind surface is $3{,}1\cdot10^{-2}$ kg, $\Delta y = 1{,}05\cdot10^{3}$ m and when the load is 2.5 H, it increases by $3{,}88\cdot10^{-3}$ m. At the same time, the speed of the blind surface increases from $0{,}87$ m/s to $2{,}15$ m/s, but it causes a decrease in the vibration amplitude of the vibration system.

For our case, the displacement in $m_n = 4{,}3\cdot10^{-2}$ kg changes within the range of $0{,}67\cdot10^{-3}$ m to $2{,}08\cdot10^{-3}$ m, and the speed range varies from $\Delta\dot{y} = 0{,}44-1{,}76$ m/s to 1.2 H to 2.5 H with an average load. shows characteristic curves with changes. The amplitude of the vibrations of the blind surface decreases with the increase of the base thickness. [3]

It can be seen that the values of the coefficient of singularity are non-linear in nature, decreasing in the range of increasing oscillations and speeds. It should be noted that the dependence on the change of the uniformity coefficient is significantly affected by the value of the resistance obtained from cotton.[4] Thus, the coefficient of uniformity of the blind surface at load 1,5 H is $0{,}5\cdot10^{3}$ n/m, the vibration is $\Delta y = 4{,}15\cdot10^{-3}$ m, and $\Delta\dot{y} = 2{,}14$ m/s. stiffness coefficient is in $2{,}25\cdot10^{3}$ n/m value, $\Delta y = 1{,}28\cdot10^{-3}$ m and $\Delta\dot{y} = 0{,}71$ m/s values at load 1.2 H. Due to the influence of the random component of the load, the deviations of the obtained parameter values do not exceed 8.0–10.0%. To ensure the desired values of the amplitude of the vibration of the blind surface, the recommended values of the coefficient of uniformity are $1{,}0-1{,}3$ n/m.

Summary

1. The formula for determining the force of interaction of cotton pieces with the blind surface was obtained. In this case, with the increase in the mass of the cotton pieces, the frequency of rotation and the radius of the piled drum, the amplitude of the vibrations of the power of the cleaner acting on the cotton pieces on the blind surface increases linearly.
2. The equations of motion of the louvered surface of the small impurity cleaner in cotton were obtained in the laws of changes of the surface affecting the cotton. The solutions of the equation of the surface vibrations of the shutter were obtained by an analytical method.
3. On the basis of the numerical solution of the problem of vibrations of the louvered surface, the laws of vibration were determined. Graphs of the dependence of the vertical vibration coverage of the blind surface on the technological resistance change were obtained.
4. It was found that increasing the uniformity of the louvered surface support leads to an increase in the frequency and a decrease in the amplitude of the vibration speed according to the non-linear graph. Recommended values of blind surface parameters: $\Delta y = (1{,}48-1{,}56)\cdot10^{-3}$ m; $c = (1{,}35-1{,}8)\cdot10^{-3}$ N/m; $m_n = (3{,}4-3{,}7)\cdot10^{-2}$ kg.

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