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# COMPACTION OF RAW COTTON DURING ITS PULSE UNLOADING INTO THE MODULES OF THE MULTILIFT SYSTEM

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**Аннотация:** В статье приведены материалы по деформации хлопка-сырца уплотняемого в кузове транспортного средства и кузовах типа «Мультилифт». Показаны возможность обеспечение различных условий нагружения на массу хлопка в равных локальных объемах.

**Ключевые слова:** хлопок-сырец, кузов, уплотнение, выгрузке, деформация, условия нагружения, локальные объемы.

**Abstract:** The article presents materials on the deformation of raw cotton compacted in vehicle bodies and multilift type bodies. The possibility of providing various loading conditions on the mass of cotton in equal local volumes is shown.

**Key words:** raw cotton, body, compaction, deformation, loading conditions, local volumes.

The solution to the problem of the peculiarities of unloading cotton from the bunker of a cotton picker into the body of a trailer with subsequent compaction of the mass was described earlier [1, 2, 3]. However, the equations in private products were not used. Therefore, we will carry out a more accurate consideration of this problem taking into account some assumptions.

1. As a model we use a compressive rod of constant cross-section F made of elastic cotton mass with uniform loading by its distributed load intensity $q_0 = \frac{P_л}{H_0}$ (Fig. 1), where $P_l$ is the force applied to the flat sealing element BV. The initial uncompacted state is characterized by the height H0 of the cotton mass placement $G_x$ and volume $V_x = в\ a\ H_0$.

The final sealed state is characterized by the displacement of the sealing element to position $B^1B^1$, volume $V_x = в\ a\ H_к$. In this case, friction forces arise on the vertical side walls $F_1 + F_2 + F_3 + F_4 + F_5$ and elastic forces $EF\ \frac{d^2u}{dz^2}$ (E – modulus of elasticity of the compressible mass of cotton). The model is characterized by the appearance of lateral pressures $q_\delta = \frac{P}{F} K_\delta$ ($K_\delta$ – lateral pressure coefficient, equivalent in physical meaning to the Punson ratio for solids).

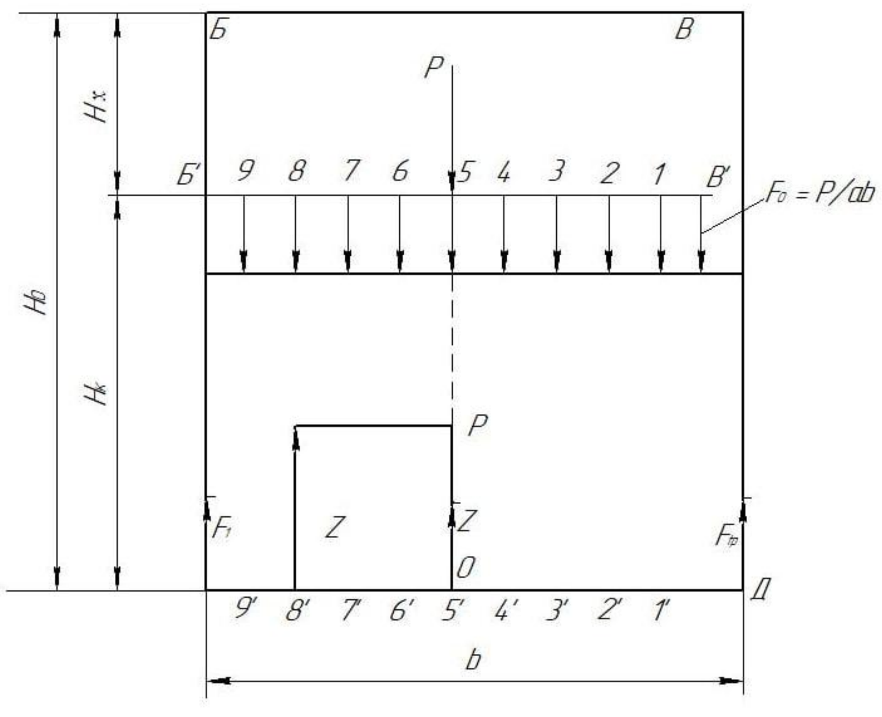


**Fig. 1. Calculation scheme of cotton compaction with a flat sealing element**

2. he function U (t, z) of compression

deformations of the cotton mass along the Z coordinate of the section placement from the support plane CD is considered to be dependent on time t. In turn, the function of compression force t - P(t) is also considered to be dependent on time t.

Therefore, the forces of specific pressure $q_\delta = (t)$ are also dependent on time t, and the friction forces

$$F_т = \frac{P(t)}{F} K_\delta \sum F_\delta \cdot f_\delta, \qquad (1)$$

where $\sum F_\delta$ – the total surface area of the side walls on which friction forces arise; $f_\delta$ – the reduced coefficient of friction of cotton on the side surfaces, which are ribbed on trailers and semi-trailers, sharply increasing $f_\delta$ compared to flat surfaces. 3. Replacing the reduced friction force $F_т$ equivalent intensity

$$q_т = \frac{F_т}{H_к} = \frac{P(t)}{F\, H_к} K_\delta \cdot f_\delta \sum F_\delta, \qquad (2)$$

the vector of which is directed in the opposite direction relative to the intensity of the external load $q_0 = \frac{P_т}{F}$. This assumption allows us to obtain the function of the total loading intensity of the cotton mass model.

$$q_в(t) = (q_0 - q_т) = \frac{P(t)}{a}\left[1 -= \frac{a}{F\, H_к} K_\delta f_\delta \sum F_\delta\right] \qquad (3)$$

4. For the adopted model, taking into account [1, 2], we use the equations of elastic compression of the sections of a model rod made of cotton mass between surfaces $B^1V^1$ and CD.

$$F\,\frac{\gamma_x}{g} \cdot \frac{d^2 u}{dt^2} - EF\,\frac{d^2 u}{dZ^2} = q(t) \qquad (4)$$

5. We accept the first version of the approximate function

$$q_в(t) = q_a sin\frac{\pi t}{2\tau_y} = \frac{P_a}{a} sin\frac{\pi t}{2\tau_y}, \qquad (5)$$

where $\tau_y$ – duration of the compaction cycle with the transition of the blade from the BV position to $B^1V^1$ at $t = \tau_y$.

We will seek the solution to equation (5) in the form

$$U_1(t,z) = U_1(z)\, sin\frac{\pi t}{2\tau_y} \qquad (6)$$

where $U_1(z)$ function of elastic deformation forms satisfying the compression condition of the cotton mass model at $t = \tau_y$.

After substituting the partial derivatives from (5) into (6), we obtain the equation

$$\frac{d^2U_1}{dz^2} + \theta_1^2 U_1 = -\frac{q_0}{EF} \qquad (7)$$

where $\theta_1^2 = \frac{\gamma_x \pi^2}{4gE\tau_y^2}$, and the function $U_1$ (1) satisfies the boundary conditions $U_1(0) = 0$

Then

$$\frac{dU_1(0)}{dz} = U_1\frac{dU_1(H_0)}{dz} = \frac{P_м}{EF} \qquad (8)$$

Solution (7) is performed by the method of operational calculus.

Let $U_1(\text{z}) \leftarrow U_1(\text{q})$, then we obtain the images of this equation

$$U_1(q) = \frac{1}{q^2+\theta^2}\left(U_1 - \frac{q_a}{qEF}\right) \qquad (9)$$

and its original

$$U_1(z) = \frac{sin\theta_1 z}{\theta_1}U_1 - \frac{q_a}{\theta_1^2 EF}(1 - cos\theta_1 z) \qquad (10)$$

To find $U_1$ we use condition (8)

$$\frac{P_м}{EF} = U_1 cos\theta_1 H_o - \frac{q_a}{\theta_1 EF} sin\theta_1 H_o$$

Where do we get it from first

$$U_1 = \frac{1}{EFcos\theta H_o}\left(P_м + \frac{q_a}{\theta_1} sin\theta_1 H_o\right) \qquad (11)$$

and then the complete solution

$$\mathcal{U}_1(t,z) =$$

$$sin\frac{\pi t}{2\tau_y}\cdot$$

$$\frac{1}{EF}\left[\frac{sin\theta_1 z}{\theta_1 cos\theta_1 H_o}\left(P_{\text{м}}+\frac{q_a}{\theta_1}sin\theta_1 H_o\right)-\frac{q_a}{\theta_1^2}(1-\right.$$
$$\left.-cos\theta)\right] \qquad (12)$$

The obtained solutions characterize layer-by-layer deformation functions that are identical for each local volume, for example 5 4 $4^1 5^1$ (Fig.) of the compacted cotton mass.

The analysis of the compression force functions P (t) shows the possibilities of providing various conditions for loading the BV surface on the cotton mass in equal local volumes. In this case, the equivalent friction forces on the side surfaces of the vehicle body model are taken into account in the form of average intensities for each local volume of the compacted cotton mass.

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