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In Article pryvedenы dependence for calculating prochnosty fybrobetonnыh elements koltsevoho cross-section normalnыh for prodolnoy wasps on the basis of major predposылok, kotorые otvechayut join the new standards natsyonalnым Ukraine.

Prochnost, element, armyrovanyya, basalt, Fibro.

The paper presents the dependences for calculation of strength ofsteel fiber-reinforced elements of circular cross-section normal to the longitudinal axis on basis of basic preconditions which meet national standards of Ukraine.

Strength, element, reinforcement, basalt, fiber.

UDC 62: 534 (031)

MATHEMATICAL MODELING OF TRANSPORTATION vibrating Forage mixture

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The mathematical model of vibration transport Forage mixture. The basic characteristics vibroreolohichni Forage mixture in the course of transportation.

***Mathematical modeling, vibration, transportation, Forage mixture*.**

Problem. When vibration in nonlinear mechanical systems having peculiar phenomena that are not inherent in linear systems. On the one hand, these effects should be considered, since they lead to unwanted side effects. On the other hand, these effects can be used to produce beneficial effects in various fields of engineering and technology (including agricultural production and processing of raw materials).

Among these events are:

1) the effect of vibration displacement Forage mixture;

2) change under the influence of vibration rheological properties of the mixture in relation to the slow effects (reduction of effective coefficients of dry friction vibration, seeming transformation of dry friction forces to viscous forces, changing the "effective viscosity" mixture when it is turbulent, etc.).

For all these processes and phenomena in Forage mixture characteristic that arise therein under vibration movements $x = X + \psi$ represent a superposition of "fast" high-frequency oscillations ψ the "slow" evolutionary movement mixtures X. The basic interest usually represents exactly slow motion.

Analysis of recent research. The main provisions of the mechanics of slow motions in nonlinear vibration in the system, a method of direct separation of motions, that approach to mathematical description and explanation of the phenomena occurring in the course vibrotransportuvannya Forage mixture contained in the II Blehmana [3].

This approach is based on the transition from the equations of motion for the total component movement x Being recorded in accordance with the ordinary laws of mechanics, the equations for the slow component X.

It turns out that the equation for X are all slow addition of forces acting on the system, some additional slow forces are calculated by a certain rule and vibration are called generalized forces. It is this method will be used in this study.

The purpose of research is to establish the basic laws vibrotransportuvannya feedstuffs vibroreolohichnyh their characteristics in the process.

Results. It should be noted that this study will be described when changing the rheological properties Forage mixture components or change patterns of behavior of the mixture as a whole under the influence of vibration will always keep in mind the characteristics and patterns in relation to the slow movement of components X.

Vibroreolohichni Forage mixture flow equation. For the last few years is typical intensity accumulation of facts and results relating to exposure to a variety of challenging environments - heterogeneous solids, bulk body mix, polymers, suspensions, Forage mixture [1, 9, 19]. The greatest interest for engineering and technology in agricultural production and processing of raw materials are cases when under the influence of vibration behavior Forage mixture changed dramatically. PA Lebinder [5] proposed to call the appropriate section vibroreolohiyeyu mechanics. By [3] defines vibroreolohiyu as mechanics, in which we study the rheological properties of bodies change with respect to the slow forces under the influence of vibration. Based on this definition, the corresponding equation can be called slow vibroreolohichnymy equations (ie equations of motion of a viscous fluid that is not compressed in the absence of volume forces):

$$\begin{cases} \rho \cdot \dfrac{\partial \vec{u}}{\partial t} + \rho \cdot \left(\vec{u} \cdot \vec{\nabla} \right) \vec{u} = -\vec{\nabla} p + \mu \nabla^2 \vec{u}; \\ \left(\vec{\nabla} \cdot \vec{u} \right) = 0, \end{cases} \quad (1)$$

where ρ - Density viscous liquid (mobile Forage mixture model); $\vec{u} = \vec{u}(x, y, z, t)$ - Vector speed; (x, y, z) - Spatial coordinates; t - Time; p - Pressure; μ - Viscosity liquid (dynamic) $\Pi a \cdot c$; $\vec{\nabla}$ - Hamiltonian operator ("approximation"); $\nabla^2 \equiv \Delta$ - Laplace operator; expressions, standing in round brackets represent the scalar product of the corresponding quantities.

In equation (1) believe that:

$$\vec{u} = \vec{U} + \vec{u}'; \qquad p = P + p', \quad (2)$$

where $\vec{U}$ and P - Slow and $\vec{u}$ and p' - Fast (pulsation) components under pressure and velocity (turbulent flow of liquid). In view of (2) and Approach II Blehmana [1] equation (1) takes the final form:

$$\begin{cases} \rho \cdot \dfrac{\partial \vec{U}}{\partial t} + \rho \cdot \left(\vec{U} \cdot \vec{\nabla} \right) \vec{U} = -\vec{\nabla} P + \mu \nabla^2 \vec{U} - \tilde{\vec{w}}; \\ \left(\vec{\nabla} \cdot \vec{U} \right) = 0, \qquad \tilde{\vec{w}} = \rho \cdot < \left(\vec{u}' \cdot \vec{\nabla} \right) \cdot \vec{u}' >, \end{cases} \quad (3)$$

which in the literature are called the Reynolds equations [2].

In (3) through $< \ldots > = \dfrac{1}{2\pi} \cdot \int_0^{2\pi} (\ldots) dr$ designated operator of averaging over the fast time $\tau = wt$ (w - Circular frequency of vibration), which is included in the expression $\tilde{W}$ explicitly:

$$\vec{u}' = w \cdot \left[A_x(x, y, z, t) \cdot \vec{i} + A_y(x, y, z, t) \cdot \vec{j} + A_z(x, y, z, t) \cdot \vec{k} \right] \cdot \sin wt, \quad (4)$$

where $\left(\vec{i}, \vec{j}, \vec{k} \right)$ - Orty vpodovzh respective axes $(0X, 0Y, 0Z)$, $\left(A_x, A_y, A_z \right)$ - Amplitude displacements (Forage mixture) vpodovzh respective axes which, in general, are functions (x, y, z, t). Whereas:

$$\frac{1}{2\pi} \int_0^{2\pi} \sin^2 \tau d\tau = \frac{1}{4\pi}, \quad (5)$$

where $\pi = 3{,}1415926$Then $\tilde{W}$ can be represented as follows:

$$\tilde{\vec{w}} = \rho \cdot \frac{w^2}{4\pi} \cdot \left\{ \begin{aligned} &\left[A_x \cdot \frac{\partial A_x}{\partial x} + A_y \frac{\partial A_x}{\partial y} + A_z \frac{\partial A_x}{\partial z} \right] \cdot \vec{i} + \\ &+ \left[A_x \cdot \frac{\partial A_y}{\partial x} + A_y \frac{\partial A_y}{\partial y} + A_z \frac{\partial A_y}{\partial z} \right] \cdot \vec{j} + \\ &+ \left[A_x \cdot \frac{\partial A_z}{\partial x} + A_y \frac{\partial A_z}{\partial y} + A_z \frac{\partial A_z}{\partial z} \right] \cdot \vec{k} \end{aligned} \right\}. \tag{6}$$

Delivers the first equation of system (3) in view of (6) as follows:

$$\frac{\partial \vec{U}}{\partial t} + \left(\vec{U} \cdot \vec{\nabla} \right) \vec{U} = -\frac{\vec{\nabla} P}{\rho} + \nu \nabla^2 \vec{U} - \frac{\tilde{\vec{w}}}{\rho}, \tag{7}$$

where $\nu = \frac{\mu}{\rho}$ - Mother kinematic viscosity, $м^2/c$.

After some mathematical transformations of equation (7) becomes:

$$\frac{\partial \vec{U}}{\partial t} + \left(\vec{U} \cdot \vec{\nabla} \right) \vec{U} = -\frac{\vec{\nabla} P}{\rho} + \nu^* \nabla^2 \vec{U}, \tag{8}$$

where $\nu^* = \nu - \dfrac{\frac{w^2}{4\pi}\left(\sum_{l=1}^{3} A_l \cdot \frac{\partial A_m}{\partial x_l} \right)}{\nabla^2 U_m}, \; m = \left(\overline{1,3}\right).$

Clearly, $\nu^* < \nu$ and allows for vibration viscosity Forage mixture. Let's make the "phenomenological" assessment ν^*. We believe that $U_m \approx V$ (Speed mass Forage mixture in a horizontal direction - vpodovzh auger axis); $A_l \approx A$ (Amplitude vibrations, m); $X_l \approx R$ (Cross auger casing radius for vibrotransportuvannya Forage mixture), m; L - Length of the auger axis (longitudinal direction), m. (Then X_l more precisely expressed as $X_l \approx \sqrt{L \cdot R}$ That is, as rms size chute for transporting Forage mixture).

Thus, we have the following two assessment ν^*:

1). $X_l \approx R$ -

$$\nu^* = \nu - \frac{\frac{w^2}{4\pi} A^2 \cdot R}{V}, \qquad \nu^* = \nu - \tilde{\nu}_{вібрації}, \; \tilde{\nu}_{вібрації} = \frac{w^2 A^2 \cdot R}{4\pi V}; \tag{9}$$

2). $X_l \approx \sqrt{L \cdot R}$ -

$$\nu^* = \nu - \frac{w^2}{4\pi} \frac{A^2 \sqrt{L \cdot R}}{V}, \qquad \nu^* = \nu - \tilde{\nu}^*_{вібрації}, \; \tilde{\nu}_{вібрації} = \frac{w^2 A^2 \sqrt{L \cdot R}}{4\pi V}. \tag{10}$$

Below, in Table. 1 shows the values of "vibration" amendments to the kinematic viscosity $\tilde{\nu}_{вібр}$ Forage mixture, which reduces its output

$\left(\nu^*\right)$ viscosity (kinematic) at $w = 2\pi \cdot 50 \, {}^{1}\!/_{c} = 314c^{-1}$, $L = 3м$ for different $A, м$ and $R, м$ at $V = 0{,}05 \, {}^{м}\!/_{c}$.

1. "Vibration" amendment $\tilde{\nu}_{вібрації}, {}^{м}\!/_{c}$ Forage mixture.

$R, м$	$A, м$				
	1 · 10-3 m	2 · 10-3 m	3 · 10-3 m	4 · 10-3 m	5 · 10-3 m
0.2	.0314	.1256	.2826	.5024	.7850
0.4	.0628	.2512	.5652	1.0048	1.5700
0.6	.0942	.3768	.8478	1.5072	2.3550
0.8	.1256	.5024	1.1304	2.0096	3.1400

Table. 2 shows the values of "vibration" amendments to the kinematic viscosity $\tilde{\nu}_{вібр}$ Forage mixture, which reduces its output $\left(\nu^*\right)$ kinematic viscosity at $w = 2\pi \cdot 50 \, {}^{1}\!/_{c} = 314c^{-1}$, $R = 0{,}4м$ for different $L, м$ and $A, м$ at $V = 0{,}05 \, {}^{м}\!/_{c}$.

2. "Vibration" amendment $\tilde{\nu}_{вібрації}, {}^{м}\!/_{c}$ Forage mixture.

$L, м$	$A, м$				
	1 · 10-3 m	2 · 10-3 m	3 · 10-3 m	4 · 10-3 m	5 · 10-3 m
1	.1000	.4000	.9000	1.6000	2.5000
3	.1732	.6928	1.5588	2.7712	4.3300
5	.2236	.8944	2.0124	3.5776	5.5900
7	.2646	1.0584	2.3814	4.2336	6.6150

Simulation of diffusion component Forage mixture during transportation by means of auger and existing fields of vibration. Similar models and processes studied for a long time Compaction of concrete mixes. Thus, in [8, 10, 11, 12] showed that the steady flow at certain parameters of vibrating concrete mixes influences also behave as Newtonian system (and Forage mixture). Therefore, it is advisable to take as a mathematical model of oscillations Forage mixture equation of motion Stokes isothermal Newtonian viscous fluid that is not compressed:

$$\frac{\partial \vec{V}}{\partial t} + \left(\vec{V} \cdot \vec{\nabla}\right)\vec{V} = \vec{F} - \frac{1}{\rho}\overrightarrow{grad}\, p + \nu \cdot \nabla^2 \cdot \vec{V}, \qquad (11)$$

or projected on 0H axis (direction of movement Forage mixture screw):

$$\frac{\partial V_x}{\partial t} = F_x - \frac{1}{\rho} \cdot \frac{\partial P}{\partial x} + \nu \cdot \left(\frac{\partial^2 V_x}{\partial x^2} + \frac{\partial^2 V_x}{\partial y^2} \right), \qquad (12)$$

where (x, y) - Cartesian coordinates, V_x - The projection of the velocity of Forage mixture axle 0H, t - Time F_x - The projection of mass forces, ρ - Forage mixture density, P - Pressure point Forage mixture, ν - Kinematic viscosity coefficient.

Size $V_x \frac{\partial V_x}{\partial x} << \frac{\partial V_x}{\partial t}$ Usually as in equations (11), (12) it can be neglected, $F_x = 0$.

According to [17] instead of $\left(-\frac{\partial p}{\partial x} \right)$ in equation (12) is introduced $E \cdot \frac{\partial^2 l}{\partial x^2}$ Where E - Modulus of elasticity, l - Move her elementary volume and velocity of fluctuations in pruzhnov'yazkomu environment, taking into account [13] may be submitted in the form $c \approx \sqrt{E / \rho}$. Then equation (12) takes the form [7]:

$$\frac{\partial V_x}{\partial t} = c^2 \cdot \frac{\partial^2 l}{\partial x^2} + \nu \cdot \left(\frac{\partial^2 V_x}{\partial x^2} + \frac{\partial^2 V_x}{\partial y^2} \right), \qquad (13)$$

where $V_x = \partial l / \partial t$ - Velocity of an elementary volume of the medium (Forage mixture) [15].

Dynamic pressure σ determined in steady state after the phase change volume Forage mixture by phase angle $\alpha = wt$ the formula:

$$\sigma = E \cdot \varepsilon = E \cdot \frac{\partial l}{\partial x}, \qquad (14)$$

where ε - Relative deformation, w - Angular velocity [4].

The physical meaning of the phase angle is to change the boundary conditions in time for the periodic law.

As you know, viscous friction (internal friction) - a friction between layers of a continuum that ranges, so instead of the second term on the right side of equation (13), especially for high pillars Forage mixture can take $\nu \frac{\partial^2 V_x}{\partial y^2}$ Where y - Coordinate that is perpendicular to the direction of travel Forage mixture (under the screw), that coordinate x.

Thus, in view of (13) the process of formation (and change shape) Forage mixture (with symmetric vertically directed vibrations) can be represented as:

$$\frac{\partial V_x}{\partial t} = c^2 \cdot \frac{\partial^2 l}{\partial x^2} + \nu \cdot \frac{\partial^2 V_x}{\partial y^2}. \qquad (15)$$

Although more precise in the equation (13).

Changing the concentration of components of the mixture during vibration system is determined by the diffusion equation Einstein-Kolmogorov [18], which is sometimes called the Fokker-Planck equation [14, 15]

$$\frac{\partial W}{\partial t} = -V \cdot \frac{\partial W}{\partial x} + D\frac{\partial^2 w}{\partial x^2}, \qquad (16)$$

where W - Volume concentration of the components of the mixture; D - Diffusion coefficient in the direction of the screw (0h axis); V - Speed of the screw (towards the axis 0h), the value of which is constant in time and process requirements set by the transport Forage mixture tray.

Thus, the original mathematical model of distribution symmetrical oscillations in two-phase medium (+ Forage mixture itself dyffunduyuchyy it specific component) has the form:

$$\begin{cases} \dfrac{\partial V_x}{\partial t} = c^2 \cdot \dfrac{\partial^2 l}{\partial x^2} + \nu \cdot \dfrac{\partial^2 V_x}{\partial y^2}; \\ \dfrac{\partial W}{\partial t} = -V \cdot \dfrac{\partial W}{\partial x} + D\dfrac{\partial^2 w}{\partial x^2}, \end{cases} \qquad (17)$$

where $c^2 = {E(x,t)}/{\rho} = \text{var};\ \rho = f_1(W);\ c = f_2(W);\ \nu = f_3(A, w, W, V) = \text{var}$.

Forage mixture density, which is an additional "diffused" component it has the form:

$$\rho = \rho_c \cdot (1 + W), \qquad (18)$$

where ρ_c - Forage mixture density in the absence of additional "dissolved" in the family component. Modulus Forage mixture with an additional component has the form:

$$E(x,t) = \frac{E_c}{1 + \dfrac{E_c}{E_k} \cdot W}, \qquad (19)$$

where E_c - Elastic modulus Forage mixture without a new component, E_k - Elastic modulus component.

In view of (18), (19) the velocity of fluctuations in Forage mixture is supplied in the form:

$$C = \frac{C_c}{\sqrt{(1+W) \cdot \left[1 + \left(\dfrac{C_c}{C_k}\right)^2 \cdot \dfrac{\rho_c}{\rho_k} \cdot W\right]}}, \qquad (20)$$

where C_c - Fluctuations in the velocity of Forage mixture without component; C_k - Fluctuations in the velocity of the component; ρ_k - Density component.

Conclusions

1. The received adequate mathematical model of vibration transport Forage mixture, such as fluctuations in the velocity of Forage mixture.

2. Received in the results can be used to further refine and improve existing engineering methods of calculation vibrotransportuvannya Forage mixture.

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Present matematycheskaya process model vybratsyonnoho transportyrovanyya kormosmesey. Main characteristics Ustanovlenы vybroreolohycheskye kormosmesey s transportyrovanyya in the process.

Mathematical Modeling, Vibrate, transportyrovanye, kormosmes.

The mathematical model of process of vibrotransportation of mixes is given. The main vibrorheological characteristics of mixes in process of transportation are established.

Mathematical modeling, vibration, transportation, feed mixture.

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MAIN METHODS find and INFORMATSIYIDLYA OF MONITORING IN UKRAINE APC

VN Bolshakov, PhD in Law
OO Brovarets, Ph.D.

The paper conducted a systematic analysis methods for information retrieval and most effective methods of monitoring (controlling and consulting "business intelligence" benchmarking), information retrieval activities, scientific literature and identified opportunities to monitor their use in agriculture Ukraine.

Monitoring Methods, search, benchmarking, *information, agriculture.*