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Abstract.*Monitoring system structure Proanalyzyrovana potentsyalnыh hazards in industry and Agrarian yspolzuemыe methods otsenki proyzvodstvennыh risks. Opysanы algorithms for determining risks and proyzvodstvennыh predelы s otsenok characteristics about A danger to workers place selskohozyaystvennoho production. For kolychestvennoho otsenki risks to mehanyzyrovannыh rastenyevodstve process in animal husbandry and proposals for the Use razrabotannыy klassyfykator.*
Keywords: proyzvodstvennыe hazards, the system control ohranoy labor, risk-oriented approach, professyonalnыy risk traktorystov-mashynystov

Annotation.*The structure of the system for monitoring potential hazards in the agricultural sector and apply methods of evaluating industrial risks are analesed. The algorithms of the determining production risks and limits of their assessments relating to the characteristics of hazards in the workplace agricultural production are described. For a quantitative risk assessment on the mechanized processes in crop and livestock production is proposed to use a developed classifier.*
Key words: industrial dangers, system safety management, risk-based approach, ***occupational hazard of tractor drivers***
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MATHEMATICAL MODELING OF RAPID GRAVITATIONAL MOVEMENT OF ANIMAL FEED INGREDIENTS IN THEIR MIXED

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Abstract. *As a result of the involvement of continuum mechanics laws, including the laws of conservation of mass, momentum change, change, angular momentum and total energy storage Mathematical*

modeling of rapid gravitational movement of bulk materials and the resulting system of equations of dynamics, which subsequently will be used to model the process dozuvalno- mixing unit in the preparation of animal feed.
Keywords: continuum, bulk materials, modeling

Formulation of the problem. Many mechanical processing of bulk materials and in particular mixing ingredients in the preparation of animal feed occur in the mode of rapid gravitational movements. Characteristic of bulk materials is the presence in them of solid particles, the space between them filled with air. In this case, granular materials represent a continuous two-phase environment and to determine their rheological ratios there is a need to involve the mechanics of multiphase media [1].

Quick gravitational movement of bulk materials accompanied by active interaction of the particles, resulting in apparent technologically significant effects of mixing and separation of the particles. The above effects are not only significantly affect the kinetics of the processes, but also often used as a base for the processes of mixing, classification, separation and others.

The main effects of interaction of bulk materials at fast gravitational movements are kvazydyfuziyne mixing and separation of the particles. To predict these effects and their management must have full information about their structural and kinematic characteristics that can be determined by solving the system of equations of the dynamics of rapid movement of bulk materials.

Analysis of recent research. Currently, the known sufficiently large number of mathematical models fast

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gravitational movements of bulk materials. Existing models can be divided into two groups: 1) based on a continuum theories based on different forms of relationship between the stress tensor and the rate of deformation; 2) based on microstructural analysis, in which tensions are determined according to the laws of momentum transfer due to collision of particles. Models of the first group are based on the fact that the properties of bulk material as the continuum can be presented in the form of continuous functions in such a way that any part without kintsevomala environment has its characteristic properties. In this case analysis of the interaction of individual particles is performed.

The problem of describing the velocity field and distribution of solid particles in granular materials fast movements seen in the work of Goodman and Kouina [2], which are based on the provisions of continuum mechanics, developed a model of rapid movement of loose material on an inclined plane.

The proposed model Sedvidzh [3] adapted to the case of fast-moving material dispersed on an inclined plane. He ruled loose material density of the number of variables and suggested the hypothesis that the stress tensor is isotropic tensor function of strain rate.

Kanatani [4] developed mikropolyarnu continuum theory that describes the rapid movement of loose material. He got an equation that defines the relationship speed and density of the medium.

K. Hutter i T. Scheiwiller [5] based continuum model Savage conducted a numerical simulation of the flow of grain, which rolled down an inclined trough. Thus, the focus was on formulating boundary conditions. The authors suggested a relationship between fluctuations in energy and speed slides and studied its importance in the fast moving grain material on an inclined surface. Formation of conditions on the border was to ensure that the quantity and flow of energy fluctuations in the direction perpendicular to the surface available, which is obviously just some partial cases of boundary conditions.

Almost all works are considered a common approach to determine the patterns of rapid gravitational movements grain materials. Moreover, the analysis can be concluded that the authors offer no transmission of momentum by moving particles kvazydyfuziynoho independence and effective friction coefficient on the concentration of solids is too conditional and in each case require serious study. For this reason, appropriate models predict the existence of stationary rapid movement of bulk materials in a range of values uzkomu angles planes. In addition, they can completely describe the velocity profile and distribution of solid phase, especially in thin layers of loose materials. In view of the above, in general, is unable to use known mathematical models to adequately describe the profiles of speed and distribution of solids in the layer thickness of bulk material.

The purpose of research. Develop a mathematical model of mathematical equations rapid gravitational movements of bulk materials and their subsequent use to describe mixing processes in the preparation of animal feed.

PThe results of research. Bulk material may be seen as a complete environment [3], for which the continuity hypothesis, and having a continuous distribution of characteristics in space. These options include bulk density bulk material $\upsilon = \upsilon(t, \vec{r})$ and velocity field $\vec{v} = \vec{v}(t, \vec{r})$. Presence of air in the space between the particles will be neglected and density particle bulk material γ we assume constant. Then the density of the medium (including the voids between particles) will be equal to:

$$\rho = \gamma \cdot \upsilon . \qquad (1)$$

Tenzor stress σ_{ik} can be represented as the sum of "equilibrium"

$\sigma_{ik}^{(r)}$Dependent on $\nabla \upsilon = \left(\partial \upsilon / \partial x, \partial \upsilon / \partial x_2, \partial \upsilon / \partial x_3\right)$And not "equilibrium" dependent $\nabla v_k = \{\partial v_k / \partial x_i\}_{i,k=1}^{3}; \sigma_{ik} = \sigma_{ik}^{(r)} + \sigma_{ik}^{(n)}$ tensor:

$$\sigma_{ik}^{r} = -\alpha\beta\left[\left(\frac{\partial \upsilon}{\partial x_1}\right)^2 + \left(\frac{\partial \upsilon}{\partial x_2}\right)^2 + \left(\frac{\partial \upsilon}{\partial x_3}\right)^2\right]\delta_{ik} - 2\alpha\frac{\partial \upsilon}{\partial x_i}\frac{\partial \upsilon}{\partial x_k}, \quad (2)$$

$$\sigma_{ik}^{(n)} = \lambda div\vec{v}\,\delta_{ik} + 2\mu V_{ik}, \quad (3)$$

where: σ_{ik} - Unit tensor; x_1, x_2, x_3 - Coordinates Cartesian coordinate system; α - Phenomenological factor; $\beta = \frac{1}{sin\varphi} - 1; \varphi$ - Internal friction angle of bulk material; λ, μ - Dynamic viscosity.

$$V_{ik} = \frac{1}{2}\left(\frac{\partial v_k}{\partial x_i} + \frac{\partial v_i}{\partial x_k}\right), \quad (4)$$

tensor velocity that matches the velocity field of the environment, moving $\vec{\upsilon} = (\upsilon_1, \upsilon_2, \upsilon_3)$:

$$div\vec{\upsilon} = \frac{\partial v_1}{\partial x_1} + \frac{\partial v_2}{\partial x_2} + \frac{\partial v_3}{\partial x_3}.$$

The equilibrium of stress tensor corresponding to the boundary of the environment when it is approaching the rest $\vec{v} = 0$. View this component chosen so that the threshold value is performed for dry Coulomb friction on:

$$|S| = f|N|,$$

where: S - Shear stress, which is defined on a plane associated with the main focus tensor $\sigma_{ik}^{(r)}; N$ - Normal stress on the same platform; f - Coefficient of internal friction bulk material.

For loose material must be carried laws of continuum mechanics [6]. Law of mass storage:

$$\frac{\partial \rho}{\partial t} + \frac{\partial \rho v_i}{\partial x_i} = 0. \quad (5)$$

Law change of momentum:

$$\rho\frac{\partial v_i}{\partial x_i} + v_k\frac{\partial v_i}{\partial x_k} = \frac{\partial \sigma_{ki}}{\partial x_k} + \rho g_i. \quad (6)$$

The law changes the angular momentum, which comes down to the moment free mechanics symmetry of the stress tensor:

$$\sigma_{ik} = \sigma_{ki}. \quad (7)$$

The law of conservation of total energy:

$$\rho\frac{\partial e}{\partial t}+\frac{\partial J_{ei}}{\partial x_i}=0, \qquad (8)$$

where: g_i - The intensity of mass forces; e - Mass density of the total energy consists of kinetic, potential and internal energy; J_{ei} - Density conductive flow total energy [7], in duplicate indexes according tensor analysis, conducted summation from 1 to 3. In the event that neglect thermal effects involve the latter value is not necessary. Given the continuity, equation (5) can be rewritten by replacing variable ρ on υ.

Fig. 1 shows a certain amount V layer of loose material lying on a hard surface Σ_0. The layer has a free surface on which there are two boundary conditions: one - scalar - kinematic character as:

$$\frac{\partial F}{\partial t}=v_z-v_x\frac{\partial F}{\partial x}-v_y\frac{\partial F}{\partial y} \qquad (9)$$

where: $z=F(t,x,y)$ is the equation free surface Γ. This condition expresses the equality of the normal particle velocity and surface speed point Γ.

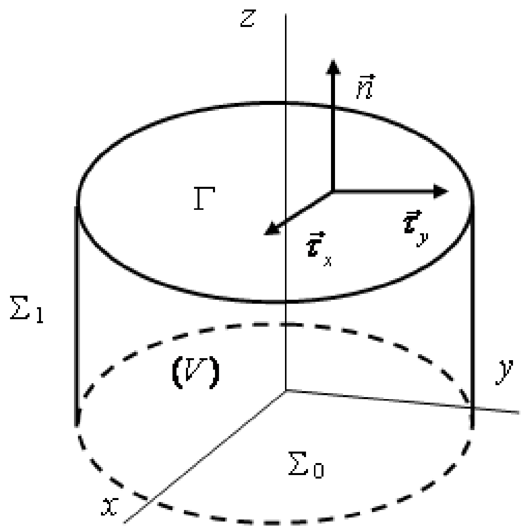

Fig. 1. The volume of bulk material layer lying on a hard surface Σ_0.

Another condition - A vector - a dynamic that expresses the continuity of the stress tensor when passing through the surface Γ. Outside capacity V no loose material, so there is the stress tensor is zero. Then the vector boundary condition is equivalent to three scalar ratio for the stress tensor, which is determined by the bulk material

$$n_k\sigma_{ki}n_i\Big|_{z=F(t,x,y)}=0, \qquad (10)$$

$$n_k\sigma_{ki}\tau_{1i}\Big|_{z=F(t,x,y)}=0, \qquad (11)$$

$$n_k \sigma_{ki} \tau_{2i} \Big|_{z=F(t,x,y)} = 0, \qquad (12)$$

where: n_k, τ_{mi} ($m=$1.2) - Unit normal and tangent vectors to the surface Γ (Fig. 1).

Also involved additional boundary condition:

$$\upsilon = \upsilon_0, \qquad (13)$$

where: υ_0 - The minimum volume density, in which the bulk environment disappears Coulomb friction between particles [3]. On firm ground Σ_0 nepronyknennya is a continuum through the wall. And if the wall is not moving in the direction of its normal, it follows that the condition neprotikannya:

$$v_z \Big|_{z=0} = 0, \qquad (14)$$

where: v_z - Normal velocity component bulk material at that surface.

In the direction along the wall Σ_0 there is slippage and loose material has the resistance movement by Coulomb's law - shear stress $\vec{p}_\tau$ proportional to the normal stress p_n and oppositely directed with respect to the relative velocity of the particle $\vec{v}(t,x,y,0) - \vec{V}(t,x,y)$ loose material on the wall:

$$\vec{p}_\tau = -\frac{\vec{v}(t,x,y,0) - \vec{V}(t,x,y)}{\left|\vec{v}(t,x,y,0) - \vec{V}(t,x,y)\right|} f_v p_n, \qquad (15)$$

where: f_v - External friction. The minus sign on the right side of the value taken due to the fact that the normal voltage should be squeezing $(p_n < 0)$. Given the relationship of the stress tensor stress as Cauchy formula [6, 8]

$$\vec{p} = p_i \vec{e}_i = n_k \sigma_{ki} \vec{e}_i,$$

vector equation (15) can be represented by two scalar relations:

$$n_k \sigma_{ki} \tau_{1i} = -\frac{v_x(t,x,y,0) - V_x(t,x,y)}{\left|\vec{v}(t,x,y,0) - \vec{V}(t,x,y)\right|} f_v n_k \sigma_{ki} n_i, \qquad (16)$$

$$n_k \sigma_{ki} \tau_{2i} = -\frac{v_y(t,x,y,0) - V_y(t,x,y)}{\left|\vec{v}(t,x,y,0) - \vec{V}(t,x,y)\right|} f_v n_k \sigma_{ki} n_i, \qquad (17)$$

where: $\vec{v} = (v_1, v_2, v_3) = (v_x, v_y, v_z)$ $\vec{\tau}_m = (\tau_{m1}, \tau_{m2}, \tau_{m3}) = (\tau_{mx}, \tau_{my}, \tau_{mz})$ single tangent to the vector.

Conclusion. As a result of reduced mathematical transformations The basic system of equations of the gravitational dynamics of rapid movement of loose material in the form of relations (16) and (17). In the future, given the equation used in determining the dosage-performance mixing unit for making animal feed.

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Abstract. *As a result of Attraction laws of mechanics sploshnыh environments, in particular laws Saving Fire-proof compounds, Changed Quantity movement, Changed kynetycheskoho moment and Saving polnoy energy held matematycheskoe Modeling Quick hravytatsyonnoho movement sыpuchyh materials and poluchena system of equations s dynamics, kotoraja in dalnejshem will be yspolzovana for modeling tehnolohycheskoho process dozyrovochno -smesytelnoho unit at pryhotovlenyy kombykormov.*

Keywords: sploshnыe environment, sыpuchye materials, modeling

Annotation. *As a result of bringing in of laws of mechanics of continuous environments, in particular laws of maintainance of mass, treason of amount of motion, the changes of kinetic moment and conservation of complete energy are conducted mathematical design of rapid gravity motion of friable materials and the system of equalizations of their dynamics which in future will be utillized for the design of technological process of dosage-mixer aggregate at preparation of the mixed fodders.*

Key words: continuous environments, friable materials, designs

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