Design procedure for determining cost cultivation oil seed plants for production biofuels. Set functional suspension cost cultivation oil seed plants its productivity.

Oil seed, winter rape, soybean, sunflower, biodiesel engine, biofuel, cost, yield.

UDC 631,361,022

MOTION DYNAMICS RESEARCH threshing Drums combine harvesters

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The presented study dynamics of combine harvester threshing drum. Research conducted for two cases change the drive point: the time constant of the drive mechanism; Parabolic change the date. The dependence of the oscillation amplitude speed beater on the hardness of the drive.

Threshing drum drive, rigidity, speed, dynamics.

Problem. Drive beater combine harvester is a complex system. Combine during harvesting threshing selects optimal speed depending on the type of culture, Moisture, relief field, the biological characteristics of culture. During start-up, and the transition to a different speed thrashing there are significant vibration beater and his drive. These vibrations are also transmitted to the bearings and the entire structure threshing-separating device itself processor and combiner. This is undesirable, since lead to a decrease in the reliability of the beater and increase energy expenditure.

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Therefore, in this paper as the basis of theoretical research be to solve problems related to the study of the effects of fluctuations in work beater.

Analysis of recent research. In [1] V. Radino, SV Kuruchuk and MS Hnutov obtained equations of nonholonomic connection of the second order, which shows its properties when you turn leniksnoyi to a combine harvester thresher drive. The authors identified three phases of leniksnoyi transmission when you switch on, and for each phase of the equations of communication. The general equation ties uniting all these phases. In this paper, the authors derived the equation, but not explored the influence of parameters to drive momentum beater.

In [2] investigated cases acceleration, coasting, driving and normal operation of the beater and the equations of motion beater. Here is a graph from which we can determine the optimal moment of inertia beater, while the average asking rate maximum external load and allowable value of technological requirements fall angular velocity.

In [3] the methods of dynamic analysis machines. The main attention is paid to the study of mathematical models of dynamic systems. Simplification methods are given dynamic models and simple linear and nonlinear modules which enable machines to make a mathematical model for the structural scheme.

However, the dynamics of movement beater unexplored.

The purpose of research is to study the dynamics of combine harvester threshing drum.

Results. To study the dynamics of beater combine harvester developed a dynamic model (Fig. 1), which is a dvomasovu dynamic model. In this model, the generalized coordinates adopted angular coordinates of the first and second masses.

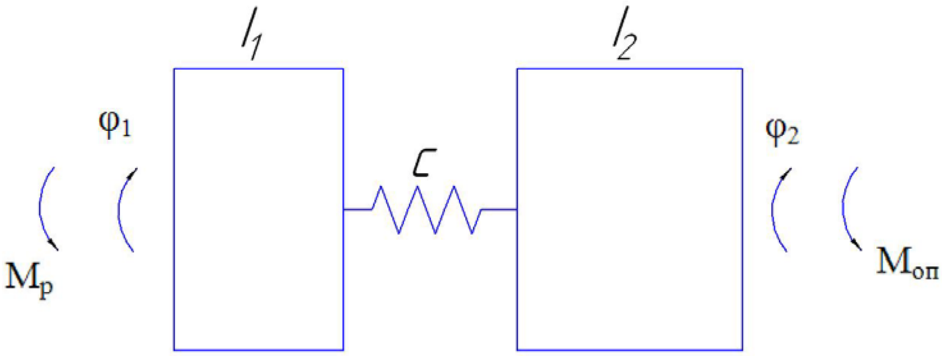


Fig. 1. The dynamic model of the drive mechanism beater.

In this model, φ1 - angular coordinate engine, built to the axis of rotation of the drum; φ2 - angular coordinate beater; J1 and J2 - moments of inertia, under the motor and drum rotation axis reduced to the drum; s - drive mechanism stiffness, reduced to the axis of rotation of the drum; Mk - driving time reduced to the axis of rotation of the drum; ILO - moment of resistance on the drum.

Based on this dynamic model composed of the equations of motion, which are as follows:

$$\begin{cases} J_1 \cdot \ddot{\varphi}_1 = M_p - c \cdot (\varphi_1 - \varphi_2); \\ J_2 \cdot \ddot{\varphi}_2 = c \cdot (\varphi_1 - \varphi_2) - M_{on}. \end{cases} \quad (1)$$

To solve the equations of motion (1) consider two cases of change of the drive point:

1. Standing time drive mechanism. $M_p = const$.

2. Parabolic change the date Drivers $M_p = A_1 \cdot \dot{\varphi}_1^2 + A_2 \cdot \dot{\varphi}_1 + A_3$ Where A1, A2, A3 - constants determined from boundary values of the driving time of the mechanical characteristics of the drive mechanism and the angular velocity.

For these two cases, we solve the system of equations and pre-build schedules angular velocity threshing.

Solution mathematical model and graph for constant since the drive mechanism.

In the first case, in the process of starting point Mk driving time is greater than the resistance of the ILO, and after time TR (acceleration time) driving time is equal to the moment of resistance (it shows a graph of points (Figure 2)).

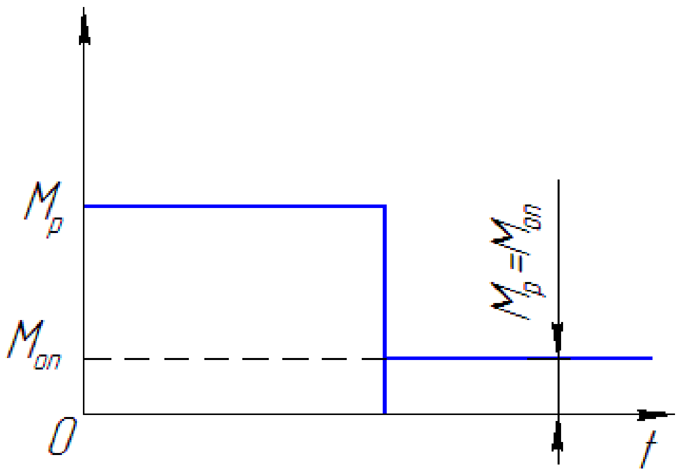


Fig. 2. Schedule changes since the resistance and the driving moment of time.

In this case, the process of moving beater in two steps. In the first stage movement driving time exceeds the time resistance. After a period of time tp, when the driving time is equal to the moment of resistance, comes the second stage, in which the driving moment is the moment of resistance.

Solve the equation of motion (1) for the first and second stages.

The first stage. At this stage, the general solution of the angular coordinates of the engine and its derivatives are as follows:

$$\varphi_1 = \frac{a_2}{2} \cdot t^2 + \left(\frac{J_2}{c} \cdot a_2 - a_1 + \frac{M_{on}}{c} \right) + a_1 \cdot \cos kt \cdot \left[1 - \frac{J_2}{c} \cdot k^2 \right];$$

$$\dot{\varphi}_1 = a_2 \cdot t - a_1 \cdot k \cdot \sin kt \cdot \left[1 - \frac{J_2}{c} \cdot k^2 \right]; \qquad (2)$$

$$\ddot{\varphi}_1 = a_2 - a_1 \cdot k^2 \cdot \cos kt \cdot \left[1 - \frac{J_2}{c} \cdot k^2 \right].$$

Coordinate beater and its derivatives:

$$\begin{aligned}
&\varphi_2 = a_1 \cdot (\cos kt - 1) + \frac{a_2}{2} \cdot t^2; \\
&\dot{\varphi}_2 = -a_1 \cdot k \cdot \sin kt + a_2 \cdot t; \\
&\ddot{\varphi}_2 = -a_1 \cdot k^2 \cdot \cos kt + a_2; \\
&\dddot{\varphi}_2 = a_1 \cdot k^3 \cdot \sin kt.
\end{aligned} \tag{3}$$

When solving the equations of motion were conducted following options:

$$k = \sqrt{\frac{J_1 + J_2}{J_1 \cdot J_2}};$$

$$a_1 = \frac{M_{on}}{J_2 \cdot k^2} + \frac{a_2}{k^2};$$

$$a_2 = \frac{M_p - M_{on}}{k^2 J_1 \cdot J_2} \cdot c.$$

When beater pick the desired speed, its equation of motion change. After time TR (acceleration time) driving time will be equal to the moment of resistance (Fig. 2).

Kinematic motion characteristics beater look like:

$$\begin{aligned}
&\varphi_2 = a_3 \cdot (\cos kt - 1); \quad \dot{\varphi}_2 = -a_3 \cdot k \cdot \sin kt; \\
&\ddot{\varphi}_2 = -a_3 \cdot k^2 \cdot \cos kt; \quad \dddot{\varphi}_2 = a_3 \cdot k^2 \cdot \sin kt,
\end{aligned} \tag{4}$$

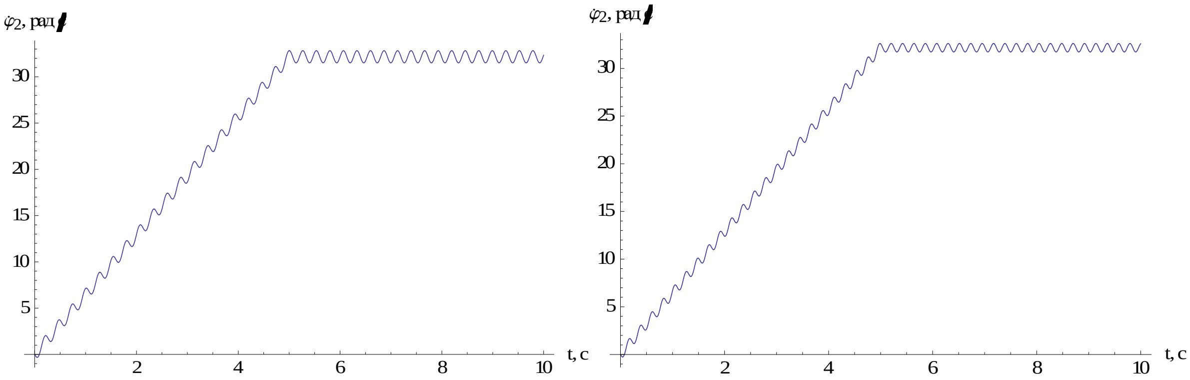
and depending on the characteristics of the motor movement after time TR:

$$\begin{aligned}
&\varphi_1 = a_3 \cdot \cos kt \cdot \left(1 - \frac{J_2}{c} \cdot k^2\right) + \frac{M_{on}}{c} - a_3; \\
&\dot{\varphi}_1 = -a_3 \cdot k \cdot \sin kt \cdot \left(1 - \frac{J_2}{c} \cdot k^2\right); \\
&\ddot{\varphi}_1 = -a_3 \cdot k^2 \cdot \cos kt \cdot \left(1 - \frac{J_2}{c} \cdot k^2\right).
\end{aligned} \tag{5}$$

To find these relationships had been replaced:

$$a_3 = \frac{M_{on}}{J_2 \cdot k^2}.$$

Equation (2) - (5) can be solved by Mathematica package. To combine with parameters: J1 = 31,5khm2; J2 = 5,22khm2; Mp = 550 nm; Mop = 350 nm. For the first case were constructed plots of velocity beater of time (Fig. 3). Depending on changes in the rigidity of the drive mechanism, the amplitude of oscillation speed beater not change significantly (Fig. 3).



a) b)

Fig. 3. The angular velocity characteristics depending beater from time to time of constant drive mechanism depending on the hardness of the surface for the angular velocity Bill 30 m / s (a - rigidity 2500 Nm / rad, B - 3700 Nm / rad).

Solution mathematical model for parabolic changes since the drive mechanism. In this case, the drive time varies according to the parabolic dependence (Fig. 4):

$$M_p = A_1 \cdot \dot{\varphi}_1^2 + A_2 \cdot \dot{\varphi}_1 + A_3 \,. \qquad (6)$$

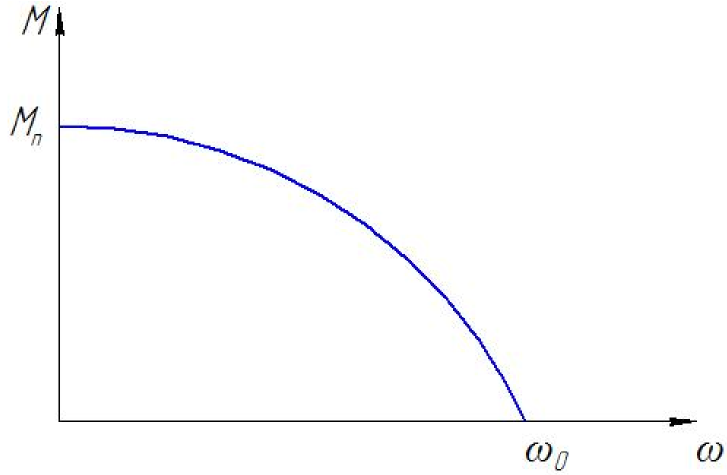


Fig. 4. Parabolic change since the drive mechanism.

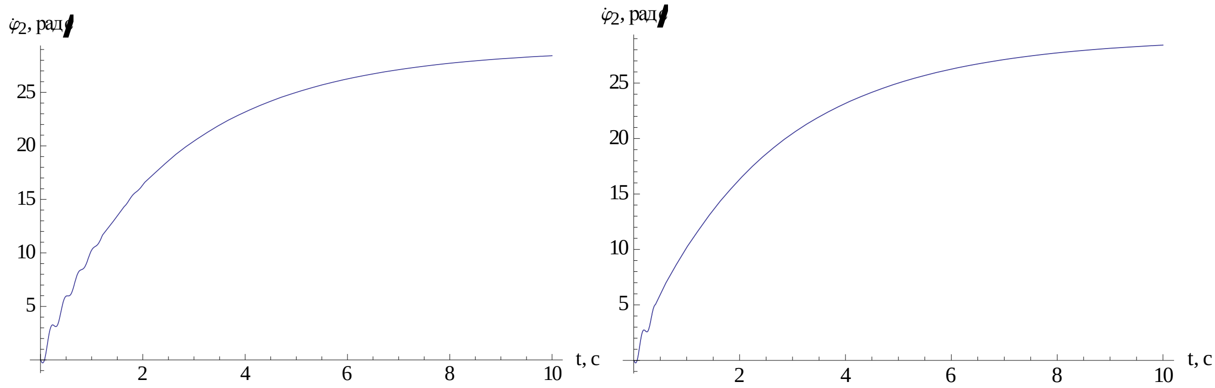
Based on boundary conditions: at t = 0, M = Mp, ω = 0; at t = tp, ω = ω0 will have a system of equations:

$$\begin{cases} A_3 = M_p; \\ A_1\omega_0^2 + A_2\omega_0 + A_3 = 0; \\ 2A_1\omega_0 + A_2 = 0. \end{cases} \qquad (7)$$

Solving this system, we get:

$$A_1 = \frac{M_p}{\omega_0^2}; \quad A_2 = -\frac{2M_p}{\omega_0}; \quad A_3 = M_p. \qquad (8)$$

Solve equation (1) based dependencies (6) and (8) using Mathematica package and build graphs of the angular velocity of the beater from time to threshing speed of 30 m / s (Fig. 5).



a) b)

Fig. 5. angular velocity characteristics depending on the time beater for parabolic changes since the drive mechanism depending on the hardness of the surface for the angular velocity Bill 30 m / s (a - stiffness of 2500 Nm / rad, B - 3700 Nm / rad).

Conclusion. After analyzing the graphs you will notice that there are fluctuations in angular velocity beater. These fluctuations are undesirable because they result in a beater vibration transmitted to the drive, the entire structure threshing unit bearings and very combiner. It is established that changing the rigidity of the drive mechanism has a significant impact on the fluctuations in angular velocity beater. Also found that movement beater is firmer at parabolic change since the drive mechanism.

References

1. *Radino* VV K neholonomnoy question about holidays in drive beater zernouborochnoho combine the regime razhona / VV Radino, SV Kurchuk, MS Hnutov // Vestnik DSTU. - 2008. - T. 8. - C. 317.
2. *Alferev SA* Study dynamics drive zernouborochnoho combine / SA Alferev // Zemledelcheskaya mechanics. - M., 1966. - Vol IX. - C.4.
3. *Kozhevnikov SN* Dynamics nestatsyonarnыh processes in machines / SN Kozhevnikov. - K .: Naukova Dumka, 1986. - 288 p.
4. *Zbigniew K.*Determination of the mass moment of drum combine harvester / *K. Zbigniew, S. Thomas*// Scientific Bulletin of National University of Life and Environmental Sciences of Ukraine. - K., 2011. - Vol. 114. - P. 208-215.
5. *Boyko AI* Changes in the level of reliability subsystems combine harvesters in unstable operation and service / AI Boyko, KM Dumenko // Scientific Bulletin of National University of Life and Environmental Sciences of Ukraine. - K., 2010. - Vol. 109. - P. 128-136.

Predstavlenы Studies movement dynamics beater zernouborochnoho combine. Studies were conducted for two cases Changed drive points: Constant time drive mechanism; Changing parabolic moment. Installed dependence amplytudы velocity fluctuations beater and engine from zhestkosty drive.

Molotylnыy drum drive, zhestkost, velocity, dynamics.

The research of dynamic motion in threshing drum of combine harvester is conducted. The research was conducted for two cases of change drive point: constant moment of drive mechanism; parabolic changing moment. The dependence of vibration amplitude of speed in threshing drum and engine from drive stiffness is established.

Threshing drum, drive, stiffness, speed, dynamic.

536 UDC: 620.178.16

Thermodynamic processes of friction and wear of structural materials

MI Denisenko, Ph.D.

In sliding form new streamlined regulatory structure-entropy. This effect can be used to adjust the properties of the tribotechnical. Using the principles of thermodynamics nezrivnovazhenyh processes in open systems proved that the friction pair corresponds to the principles of self-organization.

Energy friction theory, secondary structure, abrasive wear, entropy.

Problem. Wear parts and components business of inevitable natural process and supervising the majority of vehicles, machinery and equipment. Many researchers found that 80-90% of cases, the efficiency of machinery and equipment lost due to wear of moving joints. Fundamentals of modern concepts of friction were laid by such prominent scientists as I. KRAGELSKY, F. Bowden and D. Teybor [1-3], which greatly expanded knowledge of friction, formulated molecular and mechanical adhesion and deformation theory. According molecular-mechanical theory for external friction processes of deformation and damage of contacting surfaces may be closer to a solid surface, which it should form a thin, less sturdy than the basic material, the surface layer