Smodelyrovana sebestoymost storage semyan maslychnыh cultures. Ustanovlenы dependence sebestoymosty storage semyan maslychnыh cultures from ego humidity, zasorennosty, yield (Fire-proof compounds storage) and production equipment.

Maslychnыe culture, ozymыy rapeseed, soybean, sunflower, oil, storage, sebestoymost, yield, humidity, zasorennost.

Modeled cost of storage of oilseeds. The dependences of the cost of storage of oilseeds from its moisture, debris, yield (mass storage) and production equipment.

Oilseeds, winter rapeseed, soybean, sunflower, malayer storage, cost, yield, moisture, clogging of attorney.

UDC 693,546

RYVKOVOHO OPTIMIZATION MODE REVERSAL ROLLER MOLDING INSTALLATION

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The design roller molding installation with cam drive mechanism and built the cam profile for the combined treatment reciprocating forming trolley with ryvkovym reversal.

Roller Forming setting mode motion cam, drive.

Formulation of the problem. In installations roller forming concrete products during their work there are significant dynamic loads in elements of the drive mechanism and the elements forming carts [1-6]. Despite the rather extensive study of the process of forming concrete products bezvibratsiynym roller method [13]So far not been investigated dynamics of forming the trolley and its impact on the development. Few paid attention to driving mode and molding cart efforts arising in the elements of the drive mechanism.

Analysis of recent research. The existing theoretical and experimental research machines roller forming concrete products proved their design parameters and performance [1-3]. However, not enough attention is paid to study acting dynamic loads and modes movement, which largely affects the operation of the installation and the quality of the finished product. During the regular puskohalmivnyh modes of movement there are significant dynamic loads in elements of the drive mechanism and the elements forming the trolley, which can lead to premature failure of the installation[1-6]. So important is the problem

improving the drive mechanism roller molding installation to ensure this mode of movement forming a trolley in which decreased to dynamic loads in elements of installation and increased durability.

The purpose of research is improving the design of the drive mechanism roller molding installation to improve its reliability and durability.

Results. For roller molding installation with earthen advisable to have constant speed reciprocating forming carts throughout the area that would have a positive impact on the quality of the finished product. However, in practice such a regime can not make a motion because it lacks plot acceleration and braking, without which there can be cyclical movement. It is therefore proposed to implement a regime of movement during its formative carts move, which would reverse land with minimal dynamic loads and site traffic at a constant speed.

To smooth the process of reversing the molding cart invited to perform at its optimal mode of movement ryvkovym [7]. The rate of acceleration and mold carts vary smoothly without creating significant dynamic loads in the installation, which in turn positively affect its longevity.

Criteria mode motion machines and mechanisms can be uneven rates of movement and dynamism. [7] In this paper as a criterion motion mode used by criteria act which is an integral time of the integrand that expresses the extent of movement or action system. For ryvkovoho regime optimality criterion reversing motion will have the form:

$$I_W = \int_0^{t_p} W\,dt \to \min \quad (1)$$

where: t - Time; t_p - The duration reversal; W - Energy falls:

$$W = \frac{1}{2} \cdot m \cdot \dddot{x}^2, \quad (2)$$

where: m - Mass forming the trolley; $\dddot{x}$ - Jerk.

The condition of a minimum criterion (1) is a Poisson equation:

$$\frac{\partial W}{\partial x} - \frac{d}{dt}\frac{\partial W}{\partial \dot{x}} + \frac{d^2}{dt^2}\frac{\partial W}{\partial \ddot{x}} - \frac{d^3}{dt^3}\frac{\partial W}{\partial \dddot{x}} = 0 \text{ And } (3)$$

where: x, $\dot{x}$, $\ddot{x}$ - Coordinate displacement, velocity and acceleration of the cart.

From the expression (3) can be written:

$$\frac{\partial W}{\partial x} = \frac{\partial W}{\partial \dot{x}} = \frac{\partial W}{\partial \ddot{x}} = 0;\ \frac{\partial W}{\partial \dddot{x}} = m \cdot \dddot{x};\ \frac{d^3}{dt^3}\frac{\partial W}{\partial \dddot{x}} = m \cdot \overset{VI}{x} = 0. \quad (4)$$

From the last equation (4) we obtain the differential equation and its solutions:

$$\overset{VI}{x} = 0; \quad \overset{V}{x} = C_1; \quad \overset{IV}{x} = C_1 \cdot t + C_2; \quad \dddot{x} = \frac{1}{2} \cdot C_1 \cdot t^2 + C_2 \cdot t + C_3;$$

$$\ddot{x} = \frac{1}{6} \cdot C_1 \cdot t^3 + \frac{1}{2} \cdot C_2 \cdot t^2 + C_3 \cdot t + C_4; \quad \dot{x} = \frac{1}{24} \cdot C_1 \cdot t^4 + \frac{1}{6} \cdot C_2 \cdot t^3 + \frac{1}{2} \cdot C_3 \cdot t^2 + C_4 \cdot t + C_5; \quad (5)$$

$$x = \frac{1}{120} \cdot C_1 \cdot t^5 + \frac{1}{24} \cdot C_2 \cdot t^4 + \frac{1}{6} \cdot C_3 \cdot t^3 + \frac{1}{2} \cdot C_4 \cdot t^2 + C_5 \cdot t + C_6,$$

where: $C_1, C_2, C_3, C_4, C_5, C_6$ - Integration constant, determined from the boundary conditions.

Divide reversing the process into two stages: starting and braking. When braking initial conditions are: $t = 0$: $x = -x_1$; $\dot{x} = \dot{x}_y$; $\ddot{x} = 0$. The final terms of braking: $t = t_г$: $x = 0$; $\dot{x} = 0$; $\ddot{x} = 0$. Here x_1 - Coordinate the start of the braking process; $\dot{x}_y$ - Speed of the trolley to steady state before the brake.

When starting the initial conditions are: $t = 0$: $x = 0$; $\dot{x} = 0$; $\ddot{x} = 0$. The final conditions at start-up: $t = t_n$: $x = -x_1$; $\dot{x} = -\dot{x}_y$; $\ddot{x} = 0$.

Consider the process of braking. Substituting the boundary conditions Braking in equation (5), we get:

$$t = 0: \quad C_6 = -x_1; \quad C_5 = \dot{x}_y; \quad C_4 = 0; \quad (6)$$

$$t = t_г: \quad \begin{cases} \frac{1}{120} \cdot C_1 \cdot t_г^5 + \frac{1}{24} \cdot C_2 \cdot t_г^4 + \frac{1}{6} \cdot C_3 \cdot t_г^3 + \dot{x}_y \cdot t_г - x_1 = 0; \\ \frac{1}{24} \cdot C_1 \cdot t_г^4 + \frac{1}{6} \cdot C_2 \cdot t_г^3 + \frac{1}{2} \cdot C_3 \cdot t_г^2 + \dot{x}_y = 0; \\ \frac{1}{6} \cdot C_1 \cdot t_г^3 + \frac{1}{2} \cdot C_2 \cdot t_г^2 + C_3 \cdot t_г = 0. \end{cases} \quad (7)$$

Solving the system of equations (7), we get constant integration C_1, C_2 and C_3:

$$C_1 = \frac{360 \cdot \left(2 \cdot \frac{x_1}{t_г} - \dot{x}_y\right)}{t_г^4}; C_2 = \frac{24 \cdot \left(8 \cdot \dot{x}_y - 15 \cdot \frac{x_1}{t_г}\right)}{t_г^3}; C_3 = \frac{12 \cdot \left(5 \cdot \frac{x_1}{t_г} - 3 \cdot \dot{x}_y\right)}{t_г^2}. \quad (8)$$

After substituting defined constant of integration (6) and (8) the system (5) we obtain the function changes spurt molding cart in the inhibition of established speed $\dot{x}_y$ to a full stop:

$$\dddot{x} = 180 \cdot \left(2 \cdot \frac{x_1}{t_г} - \dot{x}_y\right) \cdot \frac{t^2}{t_г^4} + 24 \cdot \left(8 \cdot \dot{x}_y - 15 \cdot \frac{x_1}{t_г}\right) \cdot \frac{t}{t_г^3} + 12 \cdot \left(5 \cdot \frac{x_1}{t_г} - 3 \cdot \dot{x}_y\right) \cdot \frac{1}{t_г^2}, \quad (9)$$

or

$$\dddot{x} = \frac{12}{t_г^2} \cdot \left[15 \cdot \left(2 \cdot \frac{x_1}{t_г} - \dot{x}_y\right) \cdot \frac{t^2}{t_г^2} + 2 \cdot \left(8 \cdot \dot{x}_y - 15 \cdot \frac{x_1}{t_г}\right) \cdot \frac{t}{t_г} + \left(5 \cdot \frac{x_1}{t_г} - 3 \cdot \dot{x}_y\right)\right]. \quad (10)$$

Then optimality criterion movement during braking considering expressions (2) and (10) will be as follows:

$$
\begin{aligned}
I_{W г} &= \frac{m}{2}\cdot\int_0^{t_г}\ddot{x}^2\,dt = \frac{72\cdot m}{t_г^4}\cdot\int_0^{t_г}\left[15\cdot\left(2\cdot\frac{x_1}{t_г}-\dot{x}_y\right)\cdot\frac{t^2}{t_г^2}+2\cdot\left(8\cdot\dot{x}_y-15\cdot\frac{x_1}{t_г}\right)\cdot\frac{t}{t_г}+\left(5\cdot\frac{x_1}{t_г}-3\cdot\dot{x}_y\right)\right]^2 dt = \\
&= \frac{72\cdot m}{t_г^4}\cdot\int_0^{t_г}\left[\begin{array}{l}
225\cdot\left(2\cdot\frac{x_1}{t_г}-\dot{x}_y\right)^2\cdot\frac{t^4}{t_г^4}+4\cdot\left(8\cdot\dot{x}_y-15\cdot\frac{x_1}{t_г}\right)^2\cdot\frac{t^2}{t_г^2}+\left(5\cdot\frac{x_1}{t_г}-3\cdot\dot{x}_y\right)^2+ \\
+60\cdot\left(2\cdot\frac{x_1}{t_г}-\dot{x}_y\right)\cdot\left(8\cdot\dot{x}_y-15\cdot\frac{x_1}{t_г}\right)\cdot\frac{t^3}{t_г^3}+30\cdot\left(2\cdot\frac{x_1}{t_г}-\dot{x}_y\right)\cdot\left(5\cdot\frac{x_1}{t_г}-3\cdot\dot{x}_y\right)\cdot\frac{t^2}{t_г^2}+ \\
+4\cdot\left(8\cdot\dot{x}_y-15\cdot\frac{x_1}{t_г}\right)\cdot\left(5\cdot\frac{x_1}{t_г}-3\cdot\dot{x}_y\right)\cdot\frac{t}{t_г}
\end{array}\right]dt = \\
&= \frac{72\cdot m}{t_г^3}\cdot\left[\begin{array}{l}
45\cdot\left(2\cdot\frac{x_1}{t_г}-\dot{x}_y\right)^2+\frac{4}{3}\cdot\left(8\cdot\dot{x}_y-15\cdot\frac{x_1}{t_г}\right)^2+\left(5\cdot\frac{x_1}{t_г}-3\cdot\dot{x}_y\right)^2+ \\
+15\cdot\left(31\cdot\frac{x_1}{t_г}\cdot\dot{x}_y-30\cdot\frac{x_1^2}{t_г^2}-8\cdot\dot{x}_y^2\right)+10\cdot\left(10\cdot\frac{x_1^2}{t_г^2}-11\cdot\frac{x_1}{t_г}\cdot\dot{x}_y+3\cdot\dot{x}_y^2\right)+ \\
+2\cdot\left(85\cdot\frac{x_1}{t_г}\cdot\dot{x}_y-24\cdot\dot{x}_y^2-75\cdot\frac{x_1^2}{t_г^2}\right)
\end{array}\right] = \\
&= \frac{72\cdot m}{t_г^3}\cdot\left[5\cdot\frac{x_1^2}{t_г^2}-5\cdot\frac{x_1}{t_г}\cdot\dot{x}_y+\frac{4}{3}\cdot\dot{x}_y^2\right].
\end{aligned}
\tag{11}
$$

Consider the process of starting. Substituting the boundary conditions starting in equation (5), we get:

$$t=0:\quad C_4=0;\quad C_5=0;\quad C_6=0; \tag{12}$$

$$t=t_n:\quad \begin{cases}\frac{1}{120}\cdot C_1\cdot t_n^5+\frac{1}{24}\cdot C_2\cdot t_n^4+\frac{1}{6}\cdot C_3\cdot t_n^3=-x_1; \\ \frac{1}{24}\cdot C_1\cdot t_n^4+\frac{1}{6}\cdot C_2\cdot t_n^3+\frac{1}{2}\cdot C_3\cdot t_n^2=-\dot{x}_y; \\ \frac{1}{6}\cdot C_1\cdot t_n^3+\frac{1}{2}\cdot C_2\cdot t_n^2+C_3\cdot t_n=0.\end{cases} \tag{13}$$

Solving the system of equations (13), we obtain the constants of integration C_1, C_2 and C_3:

$$C_1=\frac{360\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)}{t_n^4};\, C_2=\frac{24\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)}{t_n^3};\, C_3=\frac{12\cdot\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)}{t_n^2}. \tag{14}$$

After substituting defined constant of integration (12) and (14) the system (5) we obtain the function changes spurt cart molding process starting from the real state of the movement with established speed $\dot{x}_y$:

$$\dddot{x}=180\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)\cdot\frac{t^2}{t_n^4}+24\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)\cdot\frac{t}{t_n^3}+12\cdot\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)\cdot\frac{1}{t_n^2} \tag{15}$$

or

$$\dddot{x}=\frac{12}{t_n^2}\cdot\left[15\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)\cdot\frac{t^2}{t_n^2}+2\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)\cdot\frac{t}{t_n}+\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)\right]. \tag{16}$$

Then optimality criterion motion during start taking into account the expressions (2) and (16) will be as follows:

$$I_{Wn}=\frac{m}{2}\cdot\int_0^{t_n}\ddot{x}^2\,dt=\frac{72\cdot m}{t_n^4}\cdot\int_0^{t_n}\left[15\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)\cdot\frac{t^2}{t_n^2}+2\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)\cdot\frac{t}{t_n}+\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)\right]^2 dt=$$

$$=\frac{72\cdot m}{t_n^4}\cdot\int_0^{t_n}\left[\begin{array}{l}225\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)^2\cdot\frac{t^4}{t_n^4}+4\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)^2\cdot\frac{t^2}{t_n^2}+\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)^2+\\+60\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)\cdot\frac{t^3}{t_n^3}+30\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)\cdot\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)\cdot\frac{t^2}{t_n^2}+\\+4\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)\cdot\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)\cdot\frac{t}{t_n}\end{array}\right]dt=$$

$$=\frac{72\cdot m}{t_n^3}\cdot\left[\begin{array}{l}45\cdot\left(\dot{x}_y-2\cdot\frac{x_1}{t_n}\right)^2+\frac{4}{3}\cdot\left(15\cdot\frac{x_1}{t_n}-7\cdot\dot{x}_y\right)^2+\left(2\cdot\dot{x}_y-5\cdot\frac{x_1}{t_n}\right)^2+\\+15\cdot\left(29\cdot\frac{x_1}{t_n}\cdot\dot{x}_y-30\cdot\frac{x_1^2}{t_n^2}-7\cdot\dot{x}_y^2\right)+10\cdot\left(10\cdot\frac{x_1^2}{t_n^2}-9\cdot\frac{x_1}{t_n}\cdot\dot{x}_y+2\cdot\dot{x}_y^2\right)+\\+2\cdot\left(65\cdot\frac{x_1}{t_n}\cdot\dot{x}_y-14\cdot\dot{x}_y^2-75\cdot\frac{x_1^2}{t_n^2}\right)\end{array}\right]=$$

$$=\frac{72\cdot m}{t_n^3}\cdot\left[5\cdot\frac{x_1^2}{t_n^2}-5\cdot\frac{x_1}{t_n}\cdot\dot{x}_y+\frac{4}{3}\cdot\dot{x}_y^2\right]. \quad (17)$$

The general criterion for optimal movement during reversing considering expressions (11) and (17) will be determined by the following expression:

$$I_W=I_{W\text{г}}+I_{Wn}=\frac{72\cdot m}{t_\text{г}^3}\cdot\left[5\cdot\frac{x_1^2}{t_\text{г}^2}-5\cdot\frac{x_1}{t_\text{г}}\cdot\dot{x}_y+\frac{4}{3}\cdot\dot{x}_y^2\right]+\frac{72\cdot m}{t_n^3}\cdot\left[5\cdot\frac{x_1^2}{t_n^2}-5\cdot\frac{x_1}{t_n}\cdot\dot{x}_y+\frac{4}{3}\cdot\dot{x}_y^2\right]. \quad (18)$$

Taking time equal braking trolley and its start $t_\text{г}=t_n=t_1$ Expression (18) can be represented as follows:

$$I_W=\frac{72\cdot m}{t_1^3}\cdot\left[10\cdot\frac{x_1^2}{t_1^2}-10\cdot\frac{x_1}{t_1}\cdot\dot{x}_y+\frac{8}{3}\cdot\dot{x}_y^2\right]. \quad (19)$$

For complete inequality (1) must fulfill the condition:

$$\frac{\partial I_W}{\partial x_1}=\frac{72\cdot m}{t_1^3}\cdot\left[20\cdot\frac{x_1}{t_1^2}-10\cdot\frac{\dot{x}_y}{t_1}\right]=\frac{72\cdot m}{t_1^4}\cdot\left[20\cdot\frac{x_1}{t_1}-10\cdot\dot{x}_y\right]=0. \quad (20)$$

From the expression (20) can be obtained from:

$$20\cdot\frac{x_1}{t_1}-10\cdot\dot{x}_y=0 \qquad \Rightarrow \qquad x_1=\frac{1}{2}\cdot\dot{x}_y\cdot t_1. \quad (21)$$

Substituting the second expression (21) in equation (6) and (8) integration constants obtained during braking molding cart:

$$C_1=0;\ C_2=12\cdot\frac{\dot{x}_y}{t_1^3};\ C_3=-6\cdot\frac{\dot{x}_y}{t_1^2};\ C_4=0;\ C_5=\dot{x}_y;\ C_6=-\frac{1}{2}\cdot\dot{x}_y\cdot t_1. \quad (22)$$

Then, on the basis of permanent integration (22) received the tool change displacement, velocity, acceleration and jerk molding cart during braking:

$$x=\frac{1}{2}\cdot\dot{x}_y\cdot\left(\frac{t^4}{t_1^3}-2\cdot\frac{t^3}{t_1^2}+2\cdot t-t_1\right);\qquad \dot{x}=\dot{x}_y\cdot\left(2\cdot\frac{t^3}{t_1^3}-3\cdot\frac{t^2}{t_1^2}+1\right);$$
$$\ddot{x}=6\cdot\dot{x}_y\cdot\left(\frac{t^2}{t_1^3}-\frac{t}{t_1^2}\right);\qquad \dddot{x}=6\cdot\dot{x}_y\cdot\left(2\cdot\frac{t}{t_1^3}-\frac{1}{t_1^2}\right). \tag{23}$$

Substituting the second expression (21) in equation (12) and (14), the permanent integration in the start molding cart:

$$C_1=0;C_2=12\cdot\frac{\dot{x}_y}{t_1^3};C_3=-6\cdot\frac{\dot{x}_y}{t_1^2};C_4=0;C_5=0;C_6=0. \tag{24}$$

Then, on the basis of permanent integration (24) received the tool change displacement, velocity, acceleration and jerk in the process of forming the trolley start:

$$x=\frac{1}{2}\cdot\dot{x}_y\cdot\left(\frac{t^4}{t_1^3}-2\cdot\frac{t^3}{t_1^2}\right);\qquad \dot{x}=\dot{x}_y\cdot\left(2\cdot\frac{t^3}{t_1^3}-3\cdot\frac{t^2}{t_1^2}\right);$$
$$\ddot{x}=6\cdot\dot{x}_y\cdot\left(\frac{t^2}{t_1^3}-\frac{t}{t_1^2}\right);\qquad \dddot{x}=6\cdot\dot{x}_y\cdot\left(2\cdot\frac{t}{t_1^3}-\frac{1}{t_1^2}\right). \tag{25}$$

At steady state traffic molding cart coordinate movement and speed of its center of mass described by equations [7]

$$x=x_{0y}+\frac{\left(x_{1y}-x_{0y}\right)\cdot t}{t_y};\qquad \dot{x}=\frac{\left(x_{1y}-x_{0y}\right)}{t_y}=const;\qquad \ddot{x}=0;\qquad \dddot{x}=0, \tag{26}$$

where: x_{0y} and x_{1y} - Coordinates the start and end positions in the center of mass of the trolley steady motion; t_y - The duration of the steady motion.

In (26) coordinate the initial position at the center of mass of the trolley steady movement x_{0y} taken equal x_1. Then, taking the amplitude of movement of the trolley from one extreme position to another Δx, Coordinate the final position in the center of mass of the trolley steady movement can be defined $x_{1y}=\Delta x-x_1$.

Substituting the obtained coordinates x_{0y} and x_{1y} the second expression (26) to determine the dependence of the speed of the trolley to steady $\dot{x}_y$:

$$\dot{x}_y=\frac{\Delta x-2\cdot x_1}{t_y}=\frac{\Delta x-\dot{x}_y\cdot t_1}{t_y}\qquad\Rightarrow\qquad \dot{x}_y=\frac{\Delta x}{t_y+t_1}. \tag{27}$$

Accepting the movement forming a trolley from one extreme position to another $t_з$ It can be divided into three parts: a start - t_n; a steady movement - t_y; braking - $t_г$. To ensure earthen molding cart at a constant speed on most of its working stroke take a steady traffic, for example, $t_y=\frac{2}{3}\cdot t_з$ Then, wondering condition equal time acceleration and braking, they can determine the appropriate expressions: $t_n = t_г = t_1 = {}^1\!/_6 \cdot t_з$.

Then the expressions on the speed of the trolley steady and coordinates x_1 look like:

$$\dot{x}_y = \frac{6 \cdot \Delta x}{5 \cdot t_з};\ x_1 = \frac{\Delta x}{10}. \quad (28)$$

Considering the movement forming a trolley from one extreme position to another and Substituting (28) in equation (23), (25) and (26), we obtain the tool change displacement, velocity, acceleration and jerk trolley

– the section start:

$$x = \frac{216 \cdot \Delta x}{5} \cdot \left(\frac{t^3}{t_з^3} - 3 \cdot \frac{t^4}{t_з^4} \right); \qquad \dot{x} = \frac{648 \cdot \Delta x}{5} \cdot \left(\frac{t^2}{t_з^3} - 4 \cdot \frac{t^3}{t_з^4} \right);$$
$$\ddot{x} = \frac{1296 \cdot \Delta x}{5} \cdot \left(6 \cdot \frac{t^2}{t_з^4} - \frac{t}{t_з^3} \right); \qquad \dddot{x} = \frac{1296 \cdot \Delta x}{5} \cdot \left(\frac{1}{t_з^3} - 12 \cdot \frac{t}{t_з^4} \right); \quad (29)$$

– at the site of steady movement:

$$x = \frac{\Delta x}{10} + \frac{6 \cdot \Delta x \cdot t}{5 \cdot t_з}; \qquad \dot{x} = \frac{6 \cdot \Delta x}{5 \cdot t_з} = const; \qquad \ddot{x} = 0; \qquad \dddot{x} = 0; \quad (30)$$

– braking at the site:

$$x = \frac{3 \cdot \Delta x}{5} \cdot \left(216 \cdot \frac{t^4}{t_з^4} - 72 \cdot \frac{t^3}{t_з^3} + 2 \cdot \frac{t}{t_з} + \frac{3}{2} \right); \qquad \dot{x} = \frac{6 \cdot \Delta x}{5} \cdot \left(432 \cdot \frac{t^3}{t_з^4} - 108 \cdot \frac{t^2}{t_з^3} + \frac{1}{t_з} \right);$$
$$\ddot{x} = \frac{1296 \cdot \Delta x}{5} \cdot \left(6 \cdot \frac{t^2}{t_з^4} - \frac{t}{t_з^3} \right); \qquad \dddot{x} = \frac{1296 \cdot \Delta x}{5} \cdot \left(12 \cdot \frac{t}{t_з^4} - \frac{1}{t_з^3} \right). \quad (31)$$

Zadavshys amplitude displacement molding cart $\Delta x = 0{,}4\,м$ and a total time of its movement from one extreme position to another $t_з = 3c$ By expressions (29) - (31) were calculated kinematic characteristics and graphs change displacement (Fig. 1, a), velocity (Fig. 1b), acceleration (Fig. 1,) and jerk (Fig. 1 d) forming the motion of the trolley from one extreme position to another with an optimal ryvkovym reverse mode.

Turning the first equation expressions (29) - (31) for the case where the origin is measured from the middle position moving mold trolley, we get:

– the section start:

$$x = \frac{216 \cdot \Delta x}{5} \cdot \left(\frac{t^3}{t_з^3} - 3 \cdot \frac{t^4}{t_з^4} \right) - \frac{\Delta x}{2}; \quad (32)$$

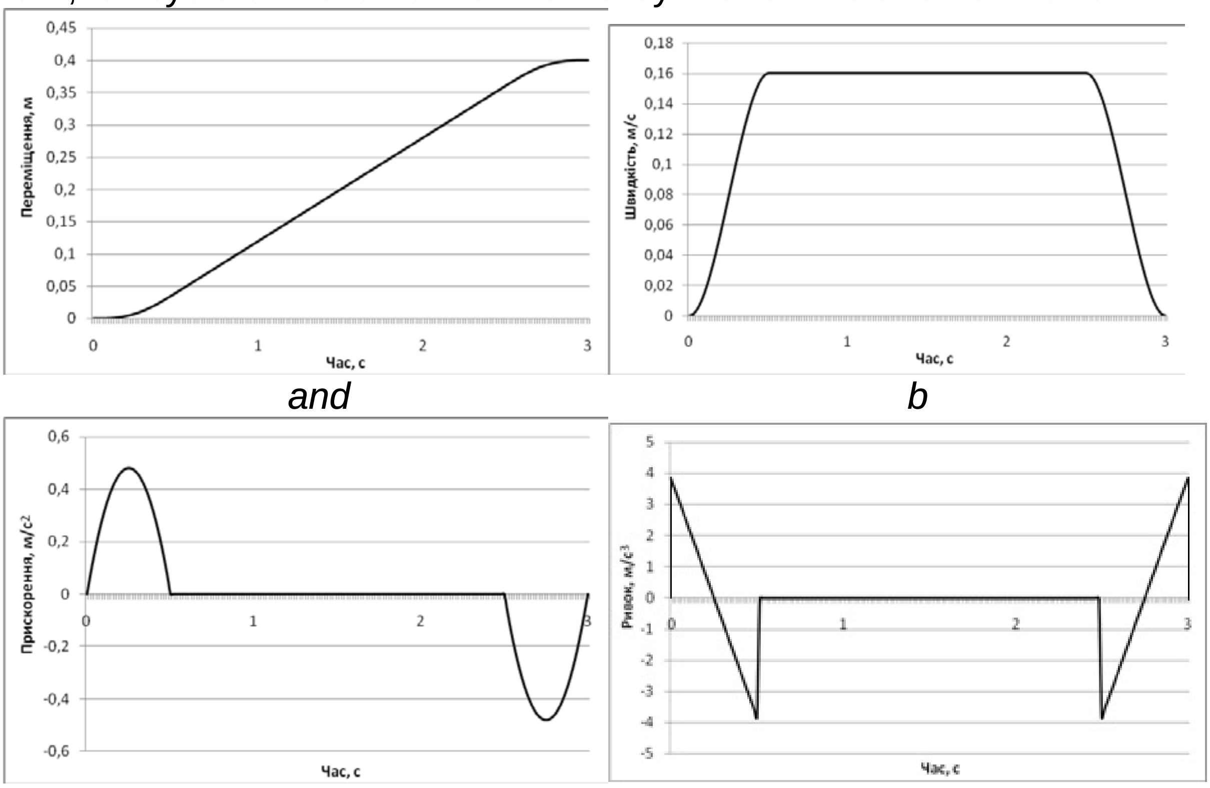
– at the site of steady movement:

$$x = \frac{2 \cdot \Delta x}{5} \cdot \left(\frac{3 \cdot t}{t_з} - 1 \right); \quad (33)$$

– braking at the site:

$$x=\frac{3\cdot\Delta x}{5}\cdot\left(216\cdot\frac{t^4}{t_з^4}-72\cdot\frac{t^3}{t_з^3}+2\cdot\frac{t}{t_з}+\frac{3}{2}\right)-\frac{\Delta x}{2}. \quad (34)$$

The law of motion of the trolley described by equations (32) - (34) can be made with the drive cam (Fig. 2) reciprocating cart. This movement of the trolley in one direction is carried out by turning the cam 1 by half a turn (ie $\varphi=\pi$) And in the opposite direction for another half a turn; full cycle of movement of the trolley - for one rotation of the cam.



and *b*

in *g*

Fig. 1. The schedule change movement - but speed - would accelerate - in and jerk - h when driving with optimum molding cart ryvkovym reverse mode.

The implementation of the law described the movement of the trolley is necessary to increase the radius of the cam consistent rate of movement of the trolley. According to the variable cam radius is determined by the relationship:

– the section start:

$$\rho=\frac{b}{2}+\frac{216\cdot\Delta x}{5}\cdot\left(\frac{t^3}{t_з^3}-3\cdot\frac{t^4}{t_з^4}\right)-\frac{\Delta x}{2}; \quad (35)$$

– at the site of steady movement:

$$\rho=\frac{b}{2}+\frac{2\cdot\Delta x}{5}\cdot\left(\frac{3\cdot t}{t_з}-1\right); \quad (36)$$

– braking at the site:

$$\rho = \frac{b}{2} + \frac{3\cdot\Delta x}{5}\cdot\left(216\cdot\frac{t^4}{t_з^4} - 72\cdot\frac{t^3}{t_з^3} + 2\cdot\frac{t}{t_з} + \frac{3}{2}\right) - \frac{\Delta x}{2} \quad (37)$$

where: b - The distance between the pushers 2 (Fig. 2).

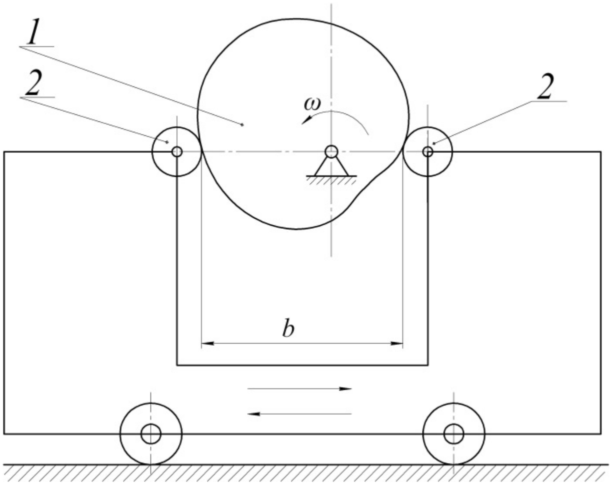


Fig. 2. Scheme of the cam mechanism driven reciprocating cart.

Time t You can exclude from the dependencies (35) - (37) as $t = \varphi/\omega$ and $t_з = \pi/\omega$. Here φ - Angular coordinate rotation cam, and ω - Angular velocity of the cam. As a starting dependence is determined by molding cart $t_п = 1/6 \cdot t_з$, The process will be carried out starting when you turn on the cam angle between $\varphi = 0$ to $\varphi = \pi/6$; a steady movement - $t_y = 2/3 \cdot t_з$ Then steady movement of the trolley will be provided for the rotation of the cam angle between $\varphi = \pi/6$ to $\varphi = 5\pi/6$; braking - $t_г = 1/6 \cdot t_з$ While braking process will be carried out when turning the cam angle in between $\varphi = 5\pi/6$ to $\varphi = \pi$. After appropriate transformations radius cam that describes its profile is associated with an angular coordinate the following expressions:

$$\rho = \frac{b}{2} + \frac{216\cdot\Delta x}{5}\cdot\left(\frac{\varphi^3}{\pi^3} - 3\cdot\frac{\varphi^4}{\pi^4}\right) - \frac{\Delta x}{2}, \qquad 0 \le \varphi \le \frac{\pi}{6}; \quad (38)$$

$$\rho = \frac{b}{2} + \frac{2\cdot\Delta x}{5}\cdot\left[3\cdot\left(\varphi - \frac{\pi}{6}\right)\cdot\frac{1}{\pi} - 1\right], \qquad \frac{\pi}{6} < \varphi < \frac{5\pi}{6}; \quad (39)$$

$$\rho = \frac{b}{2} + \frac{3\cdot\Delta x}{5}\cdot\left[\begin{array}{l} 216\cdot\left(\varphi - \frac{5\pi}{6}\right)^4\cdot\frac{1}{\pi^4} - 72\cdot\left(\varphi - \frac{5\pi}{6}\right)^3\cdot\frac{1}{\pi^3} + \\ + 2\cdot\left(\varphi - \frac{5\pi}{6}\right)\cdot\frac{1}{\pi} + \frac{3}{2} \end{array}\right] - \frac{\Delta x}{2}, \qquad \frac{5\pi}{6} < \varphi \le \pi. \quad (40)$$

Similarly, the cam profile is determined by the section of its rotation π to 2π Which describes the radius changing dependencies:

$$\rho = \frac{b}{2} - \frac{216 \cdot \Delta x}{5} \cdot \left[\frac{(\varphi - \pi)^3}{\pi^3} - 3 \cdot \frac{(\varphi - \pi)^4}{\pi^4} \right] + \frac{\Delta x}{2}, \qquad \pi \le \varphi \le \frac{7\pi}{6}; \quad (41)$$

$$\rho = \frac{b}{2} - \frac{2 \cdot \Delta x}{5} \cdot \left[1 - 3 \cdot \left(\varphi - \frac{7\pi}{6} \right) \cdot \frac{1}{\pi} \right] + \frac{\Delta x}{2}, \qquad \frac{7\pi}{6} < \varphi < \frac{11\pi}{6}; \quad (42)$$

$$\rho = \frac{b}{2} - \frac{3 \cdot \Delta x}{5} \cdot \left[\begin{array}{l} 216 \cdot \left(\varphi - \frac{11\pi}{6} \right)^4 \cdot \frac{1}{\pi^4} - 72 \cdot \left(\varphi - \frac{11\pi}{6} \right)^3 \cdot \frac{1}{\pi^3} + \\ + 2 \cdot \left(\varphi - \frac{11\pi}{6} \right) \cdot \frac{1}{\pi} + \frac{3}{2} \end{array} \right] + \frac{\Delta x}{2}, \qquad \frac{11\pi}{6} < \varphi \le 2\pi. \quad (43)$$

To prevent strikes against the cam pushers when the direction of movement of the trolley described by equations (38) - (43) of the cam profile (Fig. 3) has a vision that in any position of the diameter d - Constant and equal to the distance between the pushers b ($d = b$).

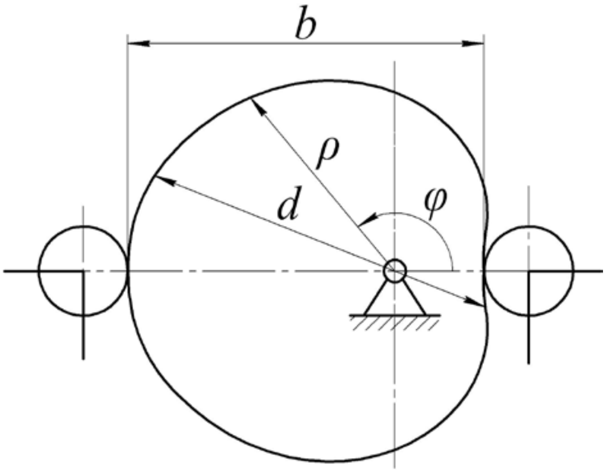


Fig. 3. The cam profile which implements the dynamic mode of movement combined molding cart.

To reduce the dynamic loads in elements of the installation and to improve its reliability invited to design the installation with a drive mechanism for reciprocating forming trolley with optimal ryvkovym reverse mode (Fig. 4). Drivers designed as pivotally mounted on the portal of the cam in contact with pushers rigidly attached to the molding cart.

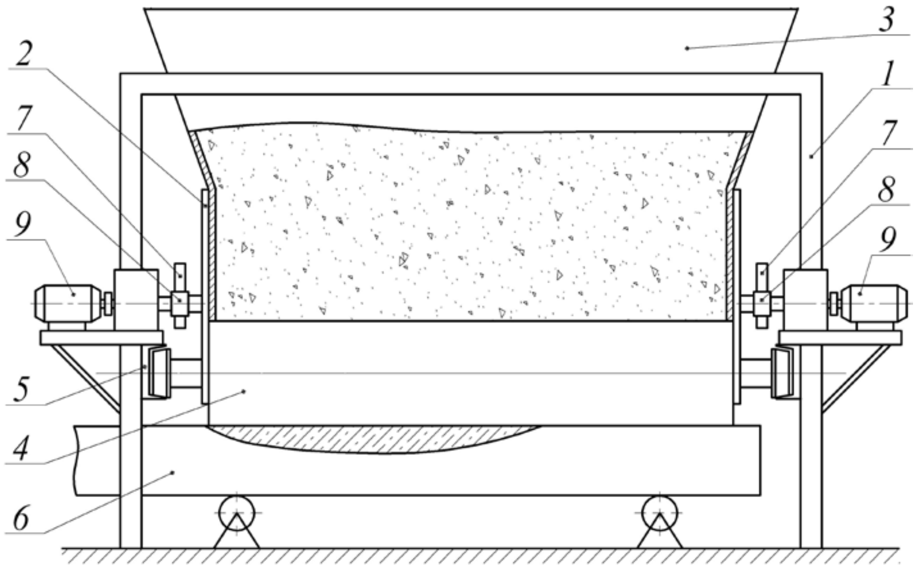


Fig. 4. Forming Roller unit with cam drive mechanism.

Set contains mounted on a stationary portal molding cart 1 2 containing the feeding hopper 3 and 4 ukochuvalni rollers and makes reciprocating motion in the guide 5 of the mold cavity 6. cart driven by reciprocating with two drives 7, attached to the portal in the form of one of two cam rotating at a constant angular velocity ($\omega = const$), But for different directions, and contact with two pushers 8 are rigidly connected to the trolley 2. Having two pushers 8 on each side molding cart 2 allows you to create a chain of hard power at its forward and reverse course.

When used to install cam drive mechanism on each side forming it impossible cart axial distortion, increased surface quality of machined concrete mix, reduced dynamic loads in elements drive devastating reduces unnecessary load on the frame structure and accordingly increases durability installation as a whole.

Conclusions

1. As a result of research to increase the reliability and durability of roller molding installation design developed it over as a cam mechanism and cam profile is constructed for reciprocating forming trolley with optimal ryvkovym reverse mode.
2. The construction molding installation with a roller cam drive mechanism on either side molding cart eliminating axial distortion, which in turn leads to improve the quality of the treated surface of the concrete mix, reducing dynamic loads in elements drive devastating reducing unnecessary loads on the frame structure and thus to improve the longevity of the installation as a whole.
3. The results may be useful in the future to refine and improve existing engineering methods for calculating the drive mechanism roller forming machine as the stages of design / construction and real operation.

List of references

1. *Garnets VM* Progressive betonoformuyuchi units and systems / VM Garnets. - K .: builder, 1991. - 144 p.
2. *Kuzin, VN* Technology roller flat molding of products IZ melkozernystыh Betonovo / VN Kuzin. - Author. Thesis ... candidate. Sc. Science. - M., 1981. - 20 p.
3. *Ryushyn VT* Study Rabocheye development process and calculation methodology roller molding machines of concrete mixtures / VT Ryushyn. - SUMMARY soyskanye uchenoy on the degree of candidate of technical sciences. - K., 1986. - 186 p.
4. *Loveykin VS* Dynamic analysis roller molding installation with rekuperatsiynym drive / VS Loveykin, KI // Kidneys dynamics, durability and reliability of agricultural machinery: Proceedings of the I-th International Scientific Conference (DSR AM-I). - Ternopol, 2004. - P. 507-514.
5. *Loveykin VS* The results of experimental studies of modes of motion roller molding installation with rekuperatsiynym drive / VS Loveykin, *KI kidney* // Journal of Kharkov National University of Agriculture. Petro Vasilenko. - Kharkiv, 2007. - Vol. 59 - T. 1. - P. 465-474.
6. *Loveykin VS* Determining the optimal crank angle displacement roller molding installation with rekuperatsiynym drive / VS Loveykin, KI // Kidneys automation of production processes in machine building and instrument making. – Lviv: "Lviv Polytechnic», 2007. - № 41. - P. 127-134.
7. *Loveykyn VS* Raschёtы optymalnыh regimes movement mechanisms of building machines / *VS Loveykyn*. - K .: PO CMD, 1990. - 168 p.

Constructions is designed rolykovoy formovochnoy installation with kulachkovыm pryvodnыm Mechanism and postroen Profil cam to implement the kombynyrovannoho mode oscillating-motion postupatelnoho formovochnoy trolley with rыvkovыm reversyrovanyem.

Rolykovaya formovochnaya setting mode motion, drives, cam mechanism.

The design of roller forming installation with the cam driving mechanism is developed and the cam profile for providing the combined mode of back and forth motion of forming cart with breakthrough reversal is constructed.

Roller forming installation, movement mode, drive, cam mechanism.