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# RESEARCH GRAIN MASS FLOW RATE IN THE CHAMBER TREATMENT OF OSCILLATING LEAKAGE

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*The process of leakage of grain processing chamber under the action of gravity and artificial vibration. Dependences of the rate and timing of grain leakage from the corner gate opening under vibration.*

***Grain weight, velocity, time of processing, opening angle, vibration, strong electric field.***

For the destruction of insect pests in grain mass by a strong electric field (SEF) is necessary to ensure effective dose treatment. The main components of dose treatment is ozone concentration and exposure time. Apparatus for processing SEF is shown in Fig. 1.

The concentration of ozone depends on the electric field in the grain mass, type of crops and grain moisture [2, 4]. Time Spent pests in EPS depends on the height of camera handling and speed of the grain mass. In the above setup [3] the movement of grain material is carried by gravity, vibration and EPS. The rate of movement of the grain mass in the chamber process affects each of the following factors. In this paper we consider the gravitational leakage grain mass under the action of vibration.

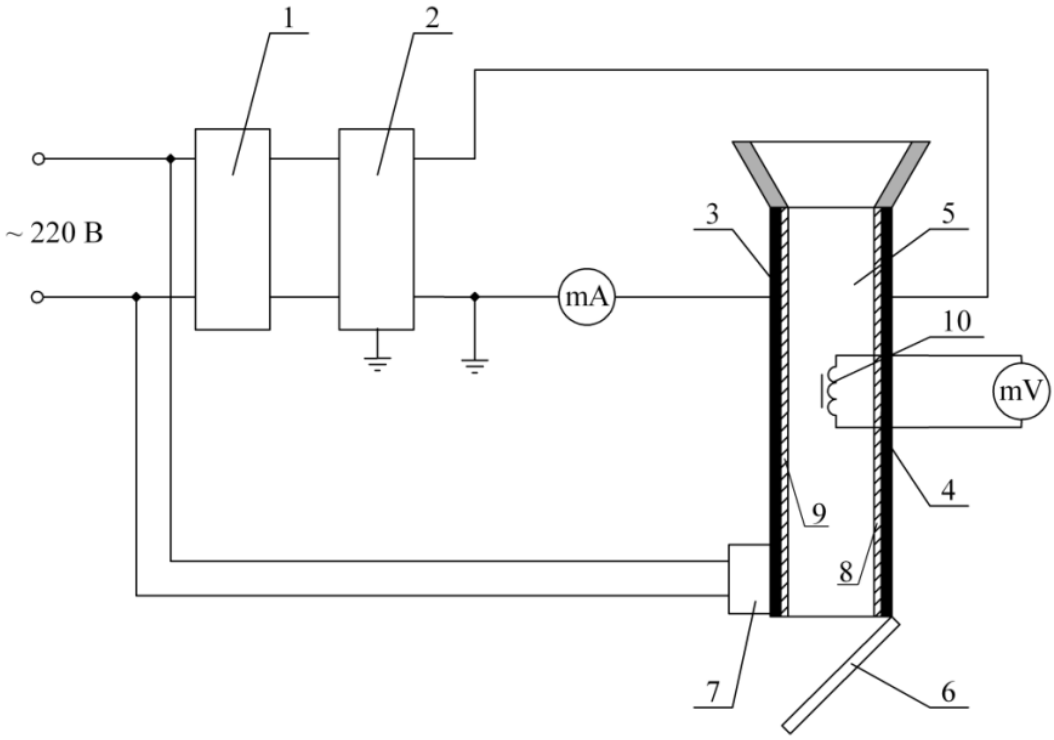


**Figure. 1. Apparatus for destroying insect pests in grain mass under SEF:**

1 - Voltage Regulator 2 - high voltage source, 3, 4 - electrodes, 5 - working chamber, 6 - gate leakage, 7 - electromagnetic vibrator, 8, 9 - insulating plates, 10 - inductive sensor

**The aim** - to study the process of grain leakage under the influence of gravitational forces and vibration theoretical basis and practical test of time and velocity dependence of leakage wheat from the shutter opening angle outflow with the influence of vibration.

**Materials and methods research.** Velocity of the grain mass in a gravitational leakage out of the hole is determined by the expression:

$$v_{a-a} = \lambda\sqrt{\sin^2\alpha + m\cos^2\alpha}\sqrt{2g(\chi R_{a-a} - \frac{\tau_0}{g\rho f})}, \quad (1)$$

where $\alpha$ - shutter opening angle (the angle of the flow of grain to the horizontal); Ra-a-section hydraulic radius Outlet m; $m$ - coefficient of flowability of grain mass, $\chi$ - coefficient depending on the size of the coefficient of internal friction in the

grain material; *f* - coefficient of internal friction of the grain material; *τ0* - initial shear stress, N/m2, *ρ* - bulk density of grain, kg/m3; *g* - acceleration due to gravity (g = 9,81 m/s2); *λ* - coefficient of leakage

Analysis of the effects of vibration on the process of gravitational leakage grain weight of the camera processing carried out using the theory of mechanics of bulk materials under variable forces and the use of mathematical modeling and practical test calculation results.

**Studies.** In Fig. 2 shows the design scheme of the grain mass outflow from the cell processing under vibration.

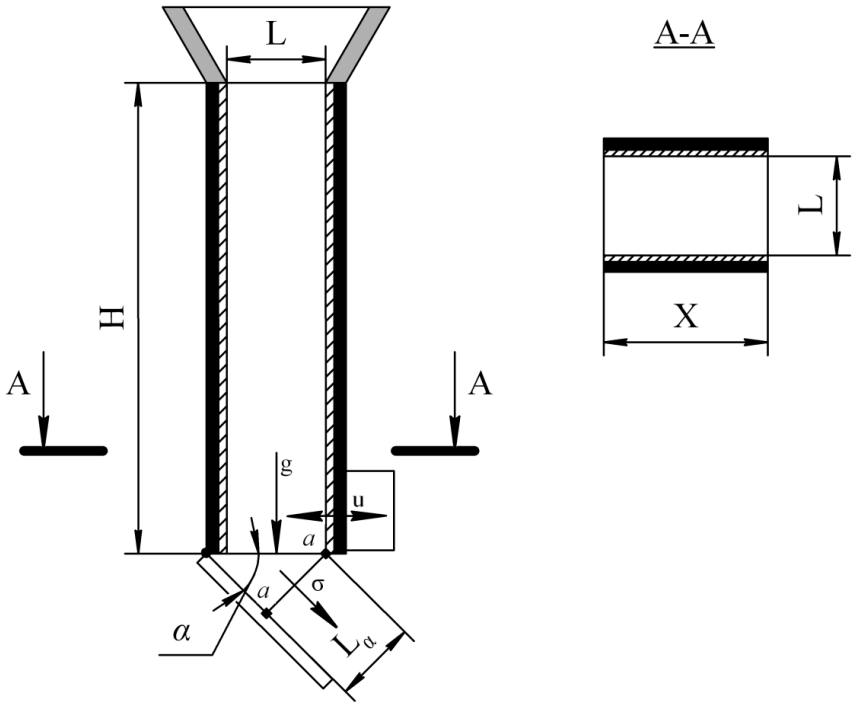


**Figure. 2. Installation Diagram for leakage under vibration**

If horizontal vibrations loose body with maximum acceleration of ± u (Fig. 3) the resultant force acting on the volume of grain mass is determined as the geometric sum of gravity and inertial forces (vibration force) [5, 7, 8]. Vector dynamic volumetric weight will have the greatest value:

$$\gamma_u = \gamma\sqrt{1+\left(\frac{u}{g}\right)^2}\,, \tag{2}$$

where $g$ - acceleration of gravity, m/s2; $u$-vibration acceleration, m/s2; $\gamma$ - bulk (bulk) weight loose body N/m3, defined by the expression

$$\gamma = \rho g\,, \tag{3}$$

where $\rho$ - bulk weight, kg/m3.

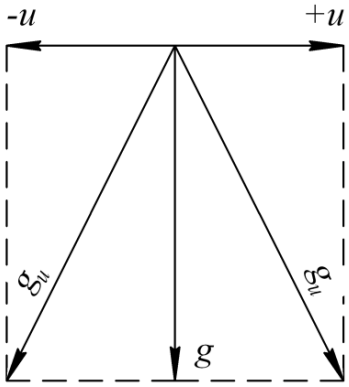


**Figure. 3. Vector addition of forces acting on the volume of grain mass**

Using (3), expression (2) can be written as:

$$g_u = g\sqrt{1+\left(\frac{u}{g}\right)^2}\,, \tag{4}$$

where $gu$ - geometric sum of the accelerations acting on the volume of grain mass m/s2.

Vibration acceleration is determined by the expression:

$$u = 4B\pi^2\nu^2, \tag{5}$$

where $B$ - amplitude, m; $v$ - frequency of oscillation, Hz.

Substituting (4) instead of g in equation (1) with (5), we obtain an expression for the determination of gravitational leakage under vibration:

$$v_{г-в} = \lambda\sqrt{\sin^2\alpha + m\cos^2\alpha}$$
$$\sqrt{2g\sqrt{1+\left(\frac{4B\pi^2\nu^2}{g}\right)^2}\left(\chi R_{а-а} - \frac{\tau_0}{g\sqrt{1+\left(\frac{4B\pi^2\nu^2}{g}\right)^2}\rho f}\right)} \quad (6)$$

Throughput processing chamber defined by the expression:

$$q_{г-в} = v_{г-в}S_{а-а} \quad (7)$$

where $Qg$-in - performance processing chamber, m3 / s; $Sa$-$a$ - area of the exhaust port, the city.

Expiration time (processing time) Grain processing from the camera:

$$t_{г-в} = \frac{V}{q_{г-в}} \quad (8)$$

where $TG$-in - leakage of grain processing chamber, c; $V$ - volume of the chamber, m3.

Average speed cameras vsr passage of grain processing:

$$v_{cp} = \frac{H}{t} \qquad (9)$$

where $H$ - height of the chamber of.

According to the established theoretical dependencies in software Mathcad 14, the calculation of time limits and the leakage rate of barley under vibration. Values of physical and mechanical properties were made for the conditions of experiments [1]. Vibration parameters are taken according to [6]: amplitude $B$ = 0,0008 m, the oscillation frequency $f$ = 50 Hz. Experimental verification of the obtained theoretical dependencies conducted on barley varieties "Solntsedar" moisture 12.5% of the crop of 2012, grown in the Kiev region. This barley covered the camera, open the shutter for a corner, turned on the vibrator and determine a leakage of grain. According to equation (9) determined the average speed of grain processing chamber.

The results of mathematical calculations and experimental data are shown in Fig. 4 and 5. With the above in Figures 4 and 5, the results show that the experimental research within the field of theoretically admissible values of time and velocity of grain processing chamber, as defined by curves 1 and 2 in Figures 3 and 4.

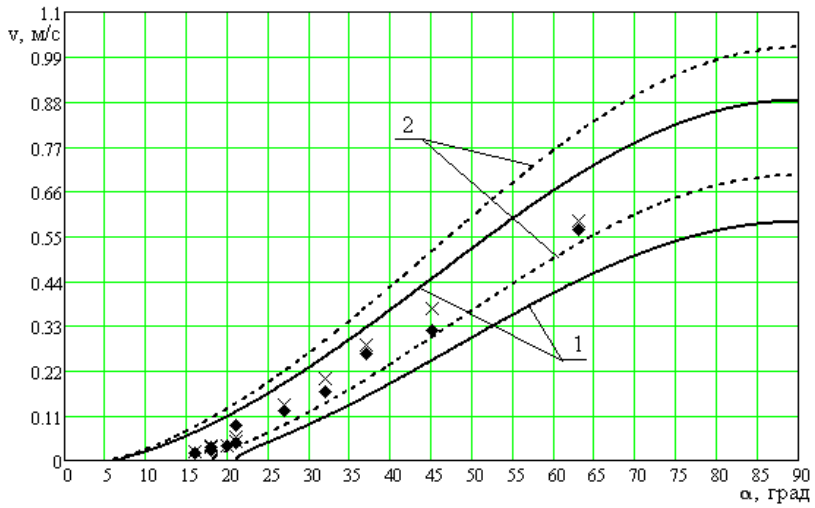


**Figure. 4. Velocity of gravitational leakage grain mass and its leakage under vibration:**

1 - upper and lower speed limits gravitational outflow of barley processing from the camera, 2 - upper and lower speed limits leakage of barley under vibration - experimental data for barley variety "Solntsedar" moisture 12.5% at gravitational leakage; × - experimental data for barley variety "Solntsedar" at 12.5% moisture leakage under vibration

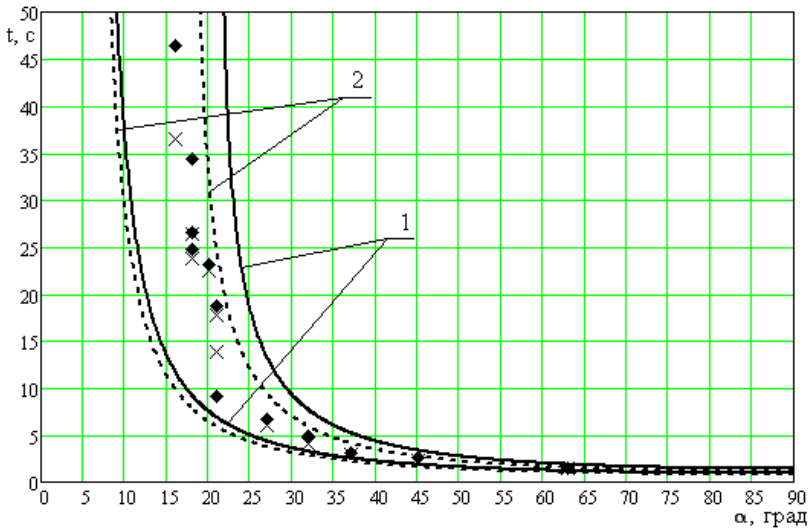


**Figure. 5. Dependence of the gravitational leakage grain mass and its leakage under vibration:**

1 - upper and lower bounds of time gravitational outflow of barley grain processing chamber, 2 - upper and lower time limit leakage of barley under vibration - experimental data for barley variety "Solntsedar" moisture 12.5% at gravitational leakage; × - experimental data for barley variety "Solntsedar" at 12.5% moisture leakage under vibration.

## Conclusions.

Based process of gravitational leakage grain weight of the camera processing under artificial vibration. The dependences of the time and the speed of gravitational leakage grain weight of the shutter opening angle outflow. These analytical expressions allow you to define the time and velocity of grain processing chamber in view of artificial vibration.

Established that under the action of vibration improves the process of grain material leakage from the cell processing: This process becomes more stable as compared to leakage without vibration and increases the velocity of grain processing chamber.

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