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# FORMALIZATION STRAIN INJURY AND grains whose surface is an ellipsoid of revolution BY

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*Theoretical calculations of various factors on the deformation and injury seeds when moving in nasinnyeochysnyh machines.*

***Grains, deformity, injury, ellipsoid, differential equations.***

**Problem.**Getting high quality seeds with a minimum number of injuries and damage is closely related to the scientific study of the processes occurring in the separation of the grain mixture. And now used Quarry nasinnyeochysni machines in its production and technical specifications do not always meet the requirements.



Due to the complexity of the process of separation also conduct research using various mathematical and physical methods. Along with the use of differential equations build dynamic models, stochastic differential equations, the equations of motion of loose material consisting of solid particles and to describe the process of segregation and distribution of grain mixture into fractions examine the dynamics of double loose environment.

Modern technology of preparing high quality seeds must meet specific requirements concerning the possibility of hard vidokremlyuvalnoho weed seeds and other crops of grain heap and minimize losses, injuries and damages, the separation of highly seeds and maximize its alignment in many ways. It is well known that not very easily shown oats and barley seeds from the seed of wheat, oats and wheat – of rye; particles radish and wild wheat – Buckwheat seeds of sorrel and legumes like.

Difficult separated seeds of weeds and cultivated plants are such size and speed of rotation and spin-greetings by the same or slightly different from the speed of rotation of the spin-greetings and basic seed culture.

To study the effectiveness of fractional shares and grain heap while preparing high-quality seeds in the separation requires some knowledge about the features of seeds as object separation.

Structural and mechanical properties of grains characterize the ability to resist deformation and injury combined with the ability to

plastically deform elastically and by external mechanical loads, and depending on the nature and magnitude of its effect on the grain size and linear shape change is occurring strain.

Overcoming the elastic and plastic deformation in zernivtsi by external forces leading to her injury and even permanent damage - damage that occurs with full force that exceeds a certain limit, called the tensile strength.

The ability of grains to resist mechanical destruction and strength will be the one that is the result of adhesion molecules forces as part weevil. At the same time prevent injury, destruction of inner strength and structural framework grains and a violation of bonds between molecules occurs deformity, trauma and broken grains strength, which contributes to its destruction.

Acting on minimizing the negative impact of strain, injury and destruction of grains, will ensure maximum achievement of quality indicators that certainly affects the growth of productive characteristics, ie quality yield.

**Analysis of recent research.** Studies show that quality indicators of grain and seeds are largely dependent on the characteristics of the variety, which certainly affect soil and climatic growing conditions.

These factors undoubtedly have a great impact on the strength ratios grains, chief among which are temperature, water and nutrient regimes predecessors, the quantity and quality of applied nutrients of protection from weeds, pests and diseases, technology, growing, harvesting, processing, etc. .

Studies show that efforts P and L strain injury and destruction caryopsides receipt mechanical stress at different stages of the process in different varieties of winter wheat, rye and other grains are also different.Δ

When exposed to destruction predecessors caryopsides noticed these researchers as EI Linkovych, KE Tolikadze, AV Pogrebnyak [8].

It is known that during intense rainfall grains, especially after the hot weather, absorb moisture, thus, studies show, GA Egorov [8] shell, germ and endosperm are filled with water, which leads to increased internal stresses and drying affects the destructive processes.

Humidity and temperature conditions weevil is one of the most important factors influencing the strength of grains, and hence their deformation, injury, destruction.

Academician PA Rebender [8] found that fluid and present it biologically active substances seep into the finest cracks, resulting in tissue wall can not close up after removal of the load due to the presence of a thin film layer of adsorbed layer, which will prevent this.

Injury caryopsides, before the failure occurs when the maximum voltage of less tension that arose as a result of mechanical or other effects. In regard to such damage occurred prerequisite $\sigma\sigma_1\sigma \leq \sigma_1$.

Due to justice provisions mechanics linear development of cracks in length should be developed to increasing in each direction by half the length of the plastic zone - where - conventional tensile strength, and COP - threshold stress intensity factor.$r_y = K_c^2/2\pi\sigma_{0.2}^2\sigma_{0.2}^2$

As a result of an increase in fictitious crack length L + elastic elements and elastoplastic solution coincide in elasticity.$r_y$

Using the threshold stress intensity factor under dovzhnyny damage according to the theory of elasticity obtain the synthesis conditions of strength, ie, when L = 0 will have a way with increasing L, decrease.$\sigma_1 = \sigma_в, \sigma_1$

If the distance between the cracks of more than 0,5 (L1 + L2), then cracks independent of one another and thus the intensity of the injury and the destruction of much covered.

It is known that the density caryopsides depends on maturation, that is what they mature, so it is higher. In this state, if the separate grains of low density, creating an opportunity to increase the biological value of the seed.

Early last century scholar WE Brencly [8] found that the main indicator of biological usefulness is its individual seed mass, which in absolute terms reflects the supply of nutrients.

Research MA Abramson and GZ Zusmanovycha [8] based on crop characteristics, specifications for size and weight of personal caryopsides found that the seed fraction isolated as the main signs need to use their thickness.

Works BM Cheremushki say that the best crop quality and harvest seeds has properties in which the optimal ratio of linear dimensions caryopsides within 1: 0, 3: 2, in which case the increase of yield compared with the control average over three years is 6.3 - 7.3 kg / ha.

Research results fractionation grain heap using sieves of different grain sorting machines show their impact on injury and distribution of quality seeds, celebrated in the works of AP Tarasenko, B. Kotov, VI Orobinskoho, ME Merchalovoyi, VV Kuznetsov, LV Fadeev and others [5, 6].

In creating the foundation of scientific foundations of the theory of interference mechanisms work surfaces and grain mixtures and vibroreshitnoho separation and fractionation to find the optimal parameters economical modes of operation covered in PV works Vasilenko, PM Zaika, VP Horyachkina, AN Pugachev, AP Tarasenko, LM Tishchenko, VV Kuznetsov and others [1, 2, 4, 7, 9, 10, 11, 12].

Research IG Strontium, AP Tarasenko, VM Drincha, PM Pugachev, SA Chazova, VI Orabinskoho [4, 9] and others suggest that caryopsides injury depends on the complex physical, mechanical and biological properties of seeds, as well as picking up and the amount of equipment on which it is preparing, it is necessary to note that the number of injured in caryopsides seed can in some cases as high as 60-90% or more.

Research Horshynskoho VV Znolin AN Tselinovskoho VM [9] and others also show the need to use fractional technology by separating the grain from the crowd heap of high quality seeds using high-performance separators and bring it to the high sowing conditions on other machines less performance, which would significantly reduce the possibility of injury to the seed.

Thus, the analysis of the impact of strain on the injury and destruction caryopsides cultivation and use of technology heap fractional preparing high-quality seeds shows that the main factors of the formation and development of a deep and comprehensive study of the physical and mechanical and biological characteristics of the seed and the development of new ways of working and modernization elements that provide the minimum number of injuries and the maximum caryopsides biologically valuable quality seeds.

**The purpose of research** – identify the impact caryopsides injury during harvesting and postharvest processing of grain heap and preparing seeds for its quality indicators monitor the efficiency of post-harvest preparation of high quality seeds of winter wheat and rye at various stages of the process, in different soil and climatic conditions.

Suggest ways to reduce injury and damage to his seed microorganisms as a major reserve increase yield crops.

**Research Methods.** Research and theoretical study performed by mathematical modeling of machines and processes. In addition, the calculation used differential equations, conversion and image definition on the basis of the laws of mechanics.

Experimental, laboratory and industrial research performed in a production environment, government laboratories, seed stations, procuring plant and schools using specimens, equipment, devices and instruments under existing state standard methods.

**Results.** For analytical study of the movement of the grain surface analytically describe the equation of an ellipsoid of revolution:

$$\frac{\xi^2+\eta^2}{h^2}+\frac{\zeta^2}{R^2}=1, \qquad (1)$$

where $R, h; \xi, \eta, \zeta$ - Respectively the radius and height of elipsnoyi grains, coordinates its surface.

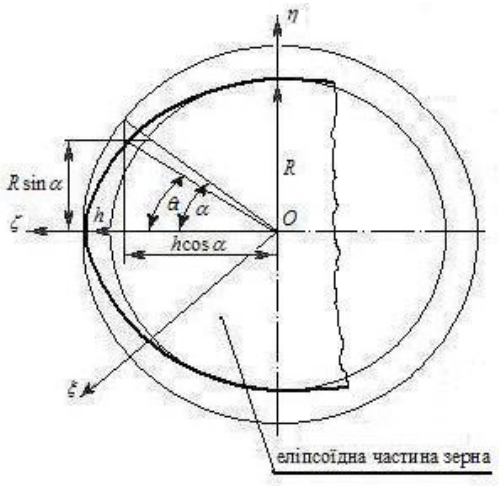


Fig. 1. Scheme of ellipsoidal grains: $R, h$ - Radius and thickness of the grain.

Under the scheme (Fig. 1) of (1) represented in parametric form:

$$\begin{aligned} \zeta &= h\cos\alpha; \\ \xi = \eta &= R\sin\alpha, \end{aligned} \tag{2}$$

where $\alpha$ and $\theta$ - The parameters of the ellipsoid of revolution.

Since options $\alpha$ and $\theta$ are in the ratio:

$$\frac{R}{h} = \frac{ctg\theta}{ctg\alpha} \tag{3}$$

then lifted equation (3) to the square ends

$$\frac{R^2}{h^2} = \frac{ctg^2\alpha}{ctg^2\alpha}. \tag{4}$$

Because $ctg\theta = \frac{\cos\theta}{\sin\theta}; \sin^2\alpha = 1 - \cos^2\alpha$ Then equation (4) becomes:

$$\frac{R^2}{h^2} = \frac{\cos^2\theta}{\sin^2\theta}\left(\frac{\cos^2\alpha}{1-\cos^2\alpha}\right)^{-1} \tag{5}$$

After some transformations, we write:

$$\frac{R^2\cos^2\alpha}{1-\cos^2\alpha} = h^2\frac{\cos^2\theta}{\sin^2\theta}. \tag{6}$$

The final payment will be as follows:

$$\cos\alpha = \frac{h\cos\theta}{\sqrt{R^2\sin^2\theta + h^2\cos^2\theta}}. \tag{7}$$

Similarly, we find the expression for $\sin\alpha$:

$$\sin\alpha = \frac{R\sin\theta}{\sqrt{R^2\sin^2\theta + h^2\cos^2\theta}}. \quad (8)$$

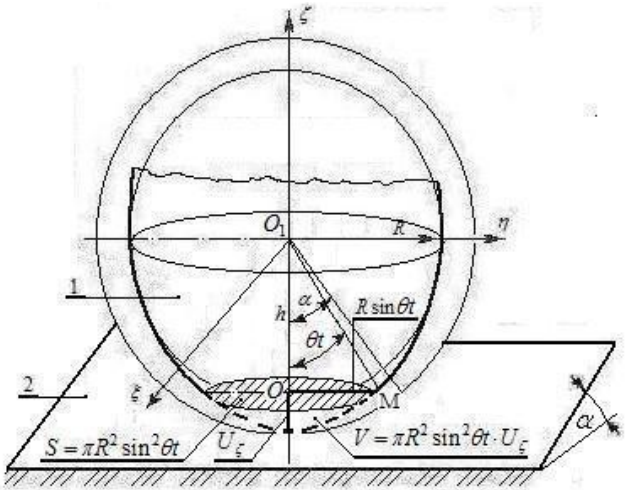


Fig. 2. Scheme displacement volume element weevil in planes coordinate system $O\xi\eta\zeta$ .

Then the equation of the circle area deformation grains (Fig. 2) takes the form:

$$S = \pi R^4 \frac{\sin^2\theta}{R^2\sin^2\theta + h^2\cos^2\theta} \quad (9)$$

where $\pi$ = 3.14 - the ratio of the circumference to its diameter deformation.

Using separate equations and circuit (Fig. 2), the amount of grains deformed in the direction of the axis $O_1\zeta$ , Formalizes the relation:

$$V = \pi R^4 \frac{\sin^2\theta U}{R^2\sin^2\theta + h^2\cos^2\theta} \quad (10)$$

where $V$ - The amount of grains deformed under the action of gravity, $м^3$, $U$ – component deformation volume of grains, $м$.

After transformations and simplifications strain rate weevil define the formula:

$$\dot{V} = \pi R^4 \frac{2\dot{\theta}\sin\theta\cos\theta[(R^2\sin^2\theta + h^2\cos^2\theta) - \sin^2\theta(R^2 - h^2)]U + \sin^2\theta(R^2 \times}{(R^2\sin^2\theta + h^2\cos^2\theta)^2}$$

$$\frac{\times\sin^2\theta + h^2\cos^2\theta)\dot{U}}{}. \quad (11)$$

Vrezultvti transformations we obtain:

$$\ddot{\theta} = (-D_2 - D_3 - \ddot{U}D_4 + g)/D_1; \quad (12)$$

$$\ddot{U} = (-\ddot{\theta}D_1 - D_2 - D_3 + g)/D_4 . \quad (13)$$

To exclude secondary derivative strain $\ddot{U}$ create equations with geometric equation provider. For this volume deformation caryopsides for external action working machine element express through radius $R$ grains and angle $\theta$ strain (Fig. 2).

After transformations we obtain:

$$\ddot{\theta} = [D_2/D_1 - D_3/D_1 - D_6D_4/D_1 + g/D_1]/(1 + D_5D_4/D_1); \quad (14)$$

$$\ddot{U} = (-\ddot{\theta}D_1 - D_2 - D_3 + g)/D_4 . \quad (15)$$

Elastic and viscous properties of the seeds are first and second components of equations (12, 13) and (14, 15), are variables that significantly affect the nature of the deformation-injury caryopsides. To change the theoretical elastic and viscous properties of the seeds should provide initial parameter value $\dot{\theta}$ dimension $c^{-1}$ That in equations reflects the dispersion parameter of external influence.

## Conclusions

As a result of the above analysis study and research the following conclusions:

- Velocity components normal and tangential strain and injury seeds expressed in terms of velocity components common ground surface caryopsides;
- The nature of the kinematic connection is that the interaction caryopsides, working machine elements and gravity, given the system of equations (10), the components of velocity and acceleration, analytically equalized; while grains deformed and injured depending on the ratio of elastic and viscous parts and moving in the direction of action of the working elements of the machine;
- Caryopsides deformation occur under a viscous-elastic body Voigt, analytically modified components of acceleration radial deformations, tangential and Coriolis nature;
- As grains of various crops vary in configuration, the components of the acceleration of motion for each case modified.

## References


1. *Vasilenko PM* Motion Theory particles on surfaces sherohovatым selskohozyaystvenыh machines / PM Vasilenko. - K .: USHA, 1960. – 284 pp.
2. *Pierre NI* Fundamentals upruhosty theory, plasticity and polzuchesty: Textbook. posobye for polytechnics / NI Pierre. - M .: Higher School, 1968. - 512 p.
3. *Belyaev NM* Resistance of materials / NM Belyaev. – M .: Nauka, 1976. – 608 pp.
4. *Dryncha VM*. Studies separatsyy semyan and technology development mashynnыh s Preparation / VM Dryncha. – Voronyzh, 2006. - 382 p.
5. *Kotov BI* Trends in the design of machines and equipment for cleaning and sorting zernomaterialiv / BI Kotov, SP Stepanenko, MG Pastushenko / KVESH machines. - Bucharest: KDTU. – 2003. – Vol. 33. – S. 53–59.

6. *Kotov BI* Theoretical study of a particle on grain vibropnevmoresheti when exposed antibonding working bodies / BI Kotov, SP Stepanenko RA Kalinichenko // Scientific bulletin NAU. – K., 2007. – Vol. 115. – S. 112–117.
7. *Prysyazhnyuk MV* Theory of vibration machines Agricultural / [MV Prysiazhnyuk, VV Adamchuk, VM Bulgakov, A. Chernish, VV Jaremenko]. – K .: Agricultural Science, 2013. – 439 pp.
8. *Yshlynskyy A.* Spatial deformation and elastic vpoyene not-binding plastycheskyh tel / AU Yshlynskyy // Izvestiya AN USSR. Here. Sc. Science. - 1945. – №3. - P. 250–260.
9. *Tarasenko AP* Reduction in travmyrovanyya semyan Other cleaning and posleuborochnoy Monitor / AP Tarasenko. - Voronyzh, 2003. - 331 p.
10. *Tishchenko LN* Vybroreshetnaya separatsyya mortars / L.N.Tyschenko, VP Olshanskyy, SV Olshanskyy. – H .: Miskdruk, 2011. – 280 pp.
11.Tymoshenko SP Exchange theory upruhosty / SP Tymoshenko.– K .: Naukova Dumka, 1972. – 501 pp.
12. Uhe J. Pneumatik separation of grain and straw mixtures / JB Uhe, B.J. Lamp. Transaction of the ASAE. - 1966. - Vol. 9. - P. 244-246.

*In Article yssleduetsya Appearance deformation and travmyrovanyya zernovky Description uh surface equation эlypsoyda treatment.*

***Zernovka, deformation, travmyrovanye, эllypsoyd, dyfferentsyalnoe equation.***

*The substantiation and theoretical calculations of effects of different factors on seed deformation and damage in process of movement are given in paper.*

***Weavil, deformation, damage, ellipsoid, differential equation.***