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Proanalyzyrovan process hemp collection and calculation pryvedenы Features constructions sektsyonnoho rest of this transporter to perform publishes operations.

Sektsyonnыy conveyor konoplezhatka, collection hemp.

Analyzed process of collecting and hemp are features of structure analysis sectional conveyor to perform this type of operations.

Sectional conveyor, hemp reaper, harvesting hemp.

UDC 631,316

PhysicallyEMERGENCE OF A NATURE AT WORK resonance vibrations Cultivator paws with elastic suspension

S.O. Gumenyuk, Ph.D.

The paper clarified the physical mechanism of resonances in the "vibration digging paw - soil" and the calculation of rational parameters of the interaction of working with soil considering significant nonlinearity legs and soil as elastic visco-plastic medium.

RezoNancy loosening, vibration, paw cultivator, soil.

Resolutionska problem. QuestionI study on rational parameters tillage work of vibrating due to the need to analyze their behavior on exposed to the soil environment, and knowledge of the processes that occur while in the soil. As any real oscillating process is accompanied by energy dissipation, it is necessary to explain the nature of the exchange of energy between the working body and the soil environment and based on this knowledge to understand the cause decrease traction resistance tillage implements.

AnaLease Finalnnih dperssurvey findings. Whatto naturaland toynykNennius wheneases working body, there are many reasons. The main ones are that the cause of the fluctuations is variable nature of the resistance of the soil, which is due to its heterogeneity and features of destruction in accordance with the three-phase nature of soil destruction [1, 3, 4, 6, 7, 11]. According to researchers, periodic shear soil under the working body and cause fluctuations in the latter.

Andnsha hypothesis is based on the fact that the cause of the oscillation is nonlinear interaction of soil with a working body under its resilient bias [5, 8, 9]. According to the authors, the interaction of the working body on the front with elastic soil environment your body begins to waver. The nature of the oscillations depends on the properties and parameters of the "elastic element - body - contacting environment." In [3] states that the optimum soil destruction is provided when the vibrating frequency of the working body should be close to the frequency of stress waves, that at resonance.

However, this applies to linear problems. Due to the nonlinearity of the soil and the working body, we have attempted to present another physically grounded excitation mechanism resonancex fluctuations in the treated soil in the interaction with paw cultivator.

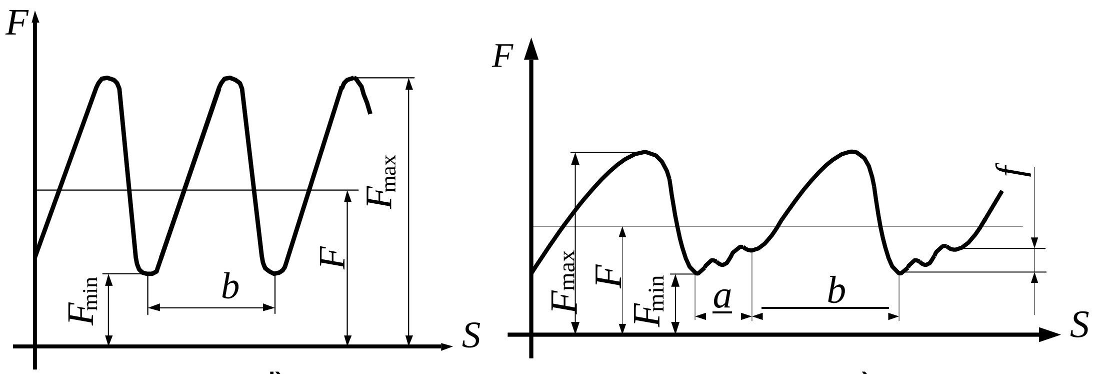
Metand lit.idzhenonfalls in z'yasuvaESI fizychnoyi naturaland (Fizychnoho mechanism) occurrence of resonances in the "vibration digging paw - soil" and the design of rational interaction parameters of working with soil considering significant nonlinearity legs and soil as elastic-visco-plastic medium.

RozrahuNOC rational parameters of the interaction of working with the soil can be conducted based on two concepts of energy exchange between the body and working environment that is processed:

1. In the system there is a main resonance $\psi hruntu / \psi lapy$ =1Ie the oscillation frequency of working body (paws) coincides with the oscillation frequency of the soil. This concept applies to linear problems.
2. Prand taking into account significant nonlinearity legs and soil as elastic visco-plastic medium, should be considered as the most favorable conditionsand the emergence subrezonansu, ie $\psi hruntu \approx \psi lapy$. If we consider

interactionsS for the second concept, while the frequency and amplitude of the resonance oscillations of soil will be determined from the nonlinear problem (nonlinear soil nonlinear paw) method of harmonic linearization.

Consonantof [6], the interaction paws on a rigid and elastic suspension of soil is described as follows. During the working body on tightand suspension, ground periodically cleave. First, the soil is compressed on the site *b*(Figure. 1, a), the resistance *F*movingS paws increases to a maximum value *Fmax*And after shearing of the soil - is reduced to a minimum *Fmin*. When moving paws on an elastic suspension at the initial time and compressed soil on the site *b*, But rejected paw against the direction of movement,
squeezingand an elastic element and accumulating potential energy of the elastic element, which gives after cleavage of the soil in the form on the site *a*(Figure. 1b).



and) to)

Rice. 1. Resistance movement of the working body on elastic and rigid suspension in the soil according to PP Karpusha and GO Riabtseva [6] as well - for
toughher suspension; b - for elastic suspension.

Usevuyuchy refer cited above work, an attempt was made to introduce another physically reasonable mechanism of excitation of resonant oscillations in the treated soil in the interaction with paw cultivator.

Given the refinements introduced in [6] the necessary formulas and patterns takes the following form (saved notation of [6]). Equal work performed by *F*(FI hard paws), and *f*tand*f'*(FI paws with elastic suspension) at the *a +b*it is possibleand
Saveand in the form:

$$f\ (a + b) = F\ (a + b) - Fa. \tag{1}$$

Whereand
$$f = F - f\ '(a / (a + b))\ (a + b)\ fa. \tag{2}$$

Actuallyis the maximum effort elastic pulse *f ''*
alternationwith real vibration amplitude can be expressed as:

$$f\ '' = \mathrm{CA} = 2f\ ', \tag{3}$$

dth*C*- Stiffness of the elastic element; *And*- Actual oscillation amplitude paws on an elastic suspension.

SizeandCAndis the maximum effort, which gives paw through the accumulated potential energy in the elastic element deviationpaws and back to equilibrium. The magnitude of the variation is due to the difference of soil resistance at the time of compression and shear.

Potentialin energy *P*That accumulates elastic element can be expressed through work *W*differenceand the resistance of the soil on the site *and.*

Potentialand energy by dependence:

$$P = Ca2 / 2. \tag{4}$$

Dll work we write:

$$W = ((Fmax - Fmin) / 2\psi) A, \tag{5}$$

Where Fma_x- Resistance tough paws at the moment of maximum compression of the soil; Fmi_n- Resistance tough paws at the time of shearing of the soil; ψ- Damping of free oscillations paws, taking into account losses in suspension.

Equatingvalue and potential energy and work, we get:

$$CA2 / 2 = ((Fma_x - Fmin) / 2\psi) A. \tag{6}$$

Subject to (2), the expression (6) can be written as:

$$f' = (Fma_x - Fmin)) / 2\psi. \tag{7}$$

Denotingand$Fma_x - Fmin = \Delta P$, We write

$$f' = \Delta P / 2\psi (Fma_x - Fmin) / 2\psi = \rightarrow \Delta P = 2\psi f.' \tag{8}$$

GroundsO values $f'$from equation (8) (2) and obtain

$$\Delta f = \Delta P / 2\psi (a / (a + b)). \tag{9}$$

and

$$f = F - \Delta f , \tag{10}$$

dthΔf- The average drag reduction paws on an elastic suspension compared with rigid; *f*- Resistance paws on an elastic suspension.

Sizeand*a* +*b*from equation (9) can be expressed through the appropriate speed and frequency:

$$A = (vM + A\omega d) / \Omega d. \tag{11}$$

$$a + b = (VM / Z), \tag{12}$$

dth*VM*- Speed of the unit, m / s; ω_d- Actual oscillation frequency during its paws in the soil, *s-1*;*And*- The average amplitude of oscillation *mm*;*Z*- Frequency shear soil paw on elastic suspension, *s-1*.

Substitutingand values *a*and*a* +*b*the expression for Δf, We obtain:

$$\Delta f = \Delta P / 2\psi (a / (a + b)) = (2\psi f ' / 2\psi) (a / (a + b)) = f' (a / (a + b)) = (CA / 2) (a / (a + b))$$

ababout

$$\Delta f = SAZ /2 ((vM + A\omega d) / (Vm\omega d)). \tag{13}$$

AfterI decomposition expression in parenthesis to terms and further transformationExpression (13) can be written as:

$$\Delta f = (Ca / 2) (Z / \omega d + Z / (vM / A)). \tag{14}$$

ababout

$$\Delta f = (Ca / 2) (Z / \omega d + 2\pi Z / (vM / A)). \tag{14.1}$$

Addedforz / ω_d- Describes subrezonansy that occur in

the soil under the influence oscillationsb paws.
AddsNOC $2\pi Z / (vM / A)$ descriptiveSouillé effectand

kinematychnohof the type that occur due to movement paws while vibrating radiation fields, that is moving paw vibration, something like the Doppler effect.

Everybodyand of these situations has its excitation conditions, including excitation threshold (the amount of energy required to excite).

Dll must occurrence subrezonansiv less energy for other things being equal (compared to the main resonance superrezonasamy and resonances of fractional order). Especially low threshold (easiest excitement has subrezonans 1/2 order. To

thingsObserved in experiments chaotic oscillations are realized primarily thanks to the existence of nonlinear system subrezonansam. Based on the available experimental and theoretical calculations presented in [6], following another physically present, the mechanism of excitation of resonant oscillations in the treated soil at

interactionswith her paw cultivator. This mechanism is that in such nonlinear mechanical systems, primarily

Stirzhuyutsya subrezonansni fluctuations (since for them the best energy terms).

Additionallyand a mechanism that contributes to subrezonansiv in this system, the kinematics features associated with this task. After

motionis a source emits vibrations to a soil processed in greater frequency than real vibration source (analog Doppler effect). The presence of other frequencies (except basic and subrezonansnoyi) in the legs and soil interaction enriches frequency spectrum impact on soil and accelerates its destruction.

ThereforeThe most profitable is this mode:

$$Z / \omega d = 1/2 \quad (Z = \omega d/2 \text{subrezonans}) \tag{15}$$

$$2\pi Z / (vM / A) = Z /(VM / 2\pi A) = 1/4 \text{ - (1/4 subrezonans order)} \tag{16}$$

$$Z = 1/4\ (vM / 2\pi A). \tag{17}$$

Considerabout asymptoticand shapeDo dlI somex caseto functionaltional system $\Delta f = (Ca / 2)\ (Z / \omega d + Z / (vM / A))$.

4. Z / ω_d <<1 - entth Shufflein rezonanwith Arosethere is Categoriesand

Dopplernd shift:

$$\Delta f = (Ca / 2)\ (Z / (vM / A)) = Z / vM. \tag{18}$$

Reductionand tyahovohabout supportsin it is possibleand getand prand augmentationand

stiffnessand suspension, increasing the amplitude, increasing frequency and decreasing soil shearing machine speed ($\Delta f \uparrow \rightarrow \uparrow C; A \uparrow; Z \uparrow; V_m \downarrow$). This option is not viable because of the need to reduce speed.

5. $VM / A >> Z$. In this case, reducing traction resistance can be obtained by increasing the stiffness of the suspension, increasing the

amplitude, increasing frequency and decreasing soil shear rate Vilnafluctuations's working body.

$$\Delta f = (Ca / 2)\ (Z / \omega d), (\Delta f \uparrow \rightarrow \uparrow C; A \uparrow; Z \quad (19)$$

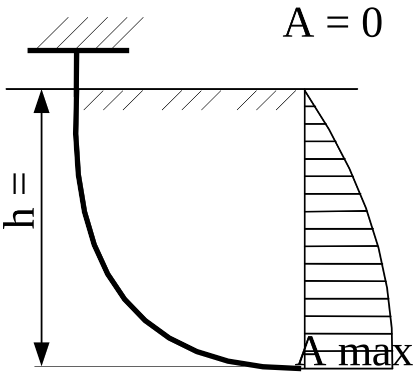
6. $Z / \omega_d \rightarrow 1$; $Z / (vM / A) \rightarrow 1$- condition, rezonanwith Dopplerand shift coincides with the frequency of chipping ground, then:

$$\Delta f = (Ca / 2)\ (1 + 1) = CA. \quad (20)$$

prand condition $VM / A = \omega d$. Because achieve $Z / \omega_d \rightarrow 1; Z / (vM / A) \rightarrow 1$ unreal, it is unrealistic condition $VM / A = \omega d$.

AvailableExperimental results and sometimes contradictory concept 1 (robust model), so to develop a more adequate model of the problem (concept 2) above calculation takes into account the option Nonlinearproperties and interactions with soil working body (improved model). Degree of adequacy of the proposed models (robust and refined) determined by the specific characteristics of the working body, or soil models.

Creem addition, to processand interactionsth vibrationth pawsand from topsoilm vynykayuting two types of resonances. The first type of resonance - resonance layer or quarter- wave resonance (at ¼ wavelength) (Fig. 2), there is provided coincidence frequencies working body and the ground and at which the maximum vibration energy dissipation in soil [3].



Rice. 2. Scheme of interaction paws with soil conditions for resonance layer of soil.

Virout to determine the resonant frequency, which occurs in the interaction legs and soil conditions for the maximum amplitude and minimum end paws at fixing has the form

$$f = c / (4hs), \quad (21)$$

dth$c$- Speed of wave propagation cleavage, m / s;h_s- Thickness of layer soilProcessed (soil depth) m.

Consonantthe theory of deformation and fracture the soil as elastic plastic medium [10] a different type of resonance - parametric, due to the fact that when applying to elementary cracks (pores) vibrations, oscillations occur in it, which lead to a change in its size (widening of cracks). Thus, for the destruction of soil is necessary that the surface energy of vibration applied to the top cracks, Enough for the widening cracks. In the process of changing the parameters associated crack stress intensity factor *Stage*,Wormsand is a constituent factor equation for determining the energy flow:

$$G = (1\text{-}v2)\ (K2 / E), \qquad (22)$$

dth*v*- Poisson's ratio; *K*- Stress intensity factor, which characterizes stress in the vicinity of the early cracks *(N / m2) m1 / 2*;*E*- Modulus of elasticity, *N / m2*.

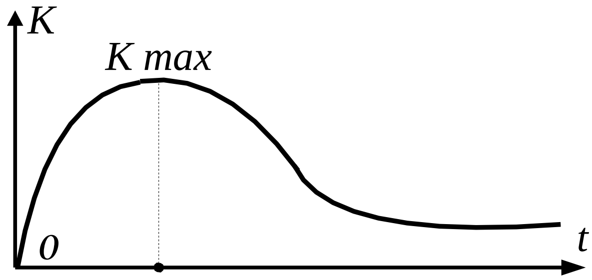
Amendmentscracks and parameters (length of) the constant vibration system "Workingand Opgan - ground» causeb dabout appearancesof parametricx resonances in the vicinity of the beginning of the crack. This is not right - the stress intensity factor becomes maximum provided:

$$(\omega\ l) / c = 1, \qquad (23)$$

dth*ω*- Frequency disturbances *rad / s*;*l*- Half the length of the soil cracks *L =2 l*,*m.*

That is,When the body is loaded impulse or harmonic load inertia effect is observed (Fig. 3). Thus, the crack length is a parameter that varies over time under vibration field, and condition (23) is the main condition for the perturbation of parametric resonance at the lowest frequency. The expression for determining the linear vibration frequency in the case of parametric resonance is:

$$fp = c / (\pi L). \qquad (24)$$



Rice. 3. inertial effect in pulsed or harmonic load.

Termsand [3] the quarter- wave resonance layer of soil that is as absorbing energy from the working body meets the conditions for the emergence of the main parametric resonance, if we assume that the rate of cleavage of wave propagation in soil that has *α*concentrationS air is determined empirical formula *c = 3,6 / (α (α-1))*,similarS the formula II Blehmana [2].

CONCLUSIONSand

1. RozrahuNOC rational parameters of the interaction of working with the soil can be conducted based on two concepts of energy exchange between

Workingof the body and the environment, which is processed: the main concept of resonance *ψhruntu / ψlapy* =1 (linear problem), and the concept subrezonansu *ψhruntu≈ψlapy*. (Including significant non-linearity legs and soil).

2. Yakscho consider the interaction concept after another, while the frequency and amplitude of the resonance oscillations of soil will be determined from the nonlinear problem (nonlinear soil nonlinear paw) method of harmonic linearization.

3. DlI The emergenceI withubrezonansito necessitiesabout lessin numberb energynd other things being equal (compared to the main resonance superrezonasamy and resonances of fractional order). Especially low threshold (easiest excitement has subrezonans 1/2 order.

4. Observationpopulations gather in experiments chaotic oscillations are realized primarily thanks to the existence of nonlinear systemsand subrezonansam.

5. Obtained in the results can be used to further improve and refine existing engineering methods for calculating ripping paws cultivators both stages of design and construction and real operation.

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In the work vыyasnen fyzycheskyy Mechanism occurrence resonances in the system "vybratsyonnaya razrыhlytelnaya paw - Soil" and conducted calculation parameters ratsyonalnыh interaction with bodies pochvoy workers with uchetom suschestvennoy nelyneynosty lapы soil and How-elastic vyazko- plastycheskoy environment.
Resonance, Rыhlenye, Vibrate, paw cultivator, soil.

The paper clarified the physical mechanism of resonances in system "oscillation tillage tool - soil" and conducted calculation of rational parameters of interaction of tillage tools with soil, taking into account material nonlinearity tools and soil as elastic-visco-plastic medium.
Resonance, loosening, vibration, cultivator share, soil.

UDC 631,794

KLAONOMIRNOSTI mechanochemical processes in abrasive wear MACHINES

M.And. Denisenko, Ph.D.

This article describes a comprehensive study of abrasive processes of machine parts and working bodies, assessment deformation mechanics and chemical interaction with the environment.
Abrasive wear, working parts, friction surfaces, vomer plow.

Resolutionska problem. PEid term "abrasions" mean the destruction of friction surfaces under the influence of particulate matter that is in the area of friction. Thus, this type of attribute depreciation vyzyvayetsya particles that are separated by friction. Abrasive wear for a long time tied exclusively Trailer influence of abrasive particles that seemed obvious, and for many decades did not suffer any doubts. Studies have shown that abrasive particles contacting