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Energy Performance Indicators

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ABSTRACT. The article presents the results of theoretical research to determine the tensile strength of the working body based on the basic values of the solvent and the physical and mechanical properties of the soil.

KEYWORDS :tractor, harrow, physical and mechanical properties of soil, working body, power, parameter, lapa, speed of movement, softening, traction resistance

I.INTRODUCTION

The results of the experiments indicate the negative impact of the propellers of the "Magnum-8940" tractor on the soil in the zone of saline lands, which include most of them in the Republic of Karakalpakstan, where flush irrigation is used.

Therefore, it is recommended to use track eradicators for general purpose tractors. The track eradicator is designed to loosen the traces of tractor propellers during the operation of preparing the soil for sowing (harrowing the soil, leveling and growing) cotton and other crops. It has been established that the best quality of sealing the traces of the tractor propellers with a minimum traction resistance is ensured when the wing paws are installed on the track eradicator.

II. SIGNIFICANCE OF THE SYSTEM

The article presents the results of theoretical research to determine the tensile strength of the working body based on the basic values of the solvent and the physical and mechanical properties of the soil. The study of literature survey is presented in section III, methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and conclusion.

III. METHODOLOGY

The pointed paw works as a symmetrical triangular wedge, the action of which is described in the works of V.P.Goryachkin, G.N.Sineokov, A.N.Zelenin, N.I.Klenin, R.I.Baimetov, M.Muratov, A.Tukhtakuziev and other scientists.

The nature of soil destruction depends on its physical, mechanical and technological properties, as well as the crumbling angles ***(β)*** and solution ***(2γ)*** of the paw (Fig. 1).

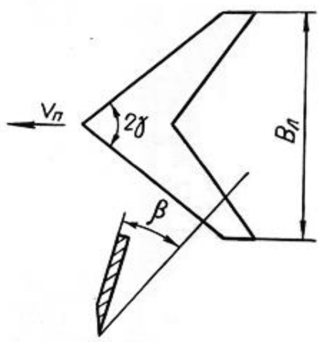

Fig. 1. The studied parameters of the duckfoot

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When loosening the soil, the wings of the paw cut the layer at a given depth ***(H)***and working width ***(V_l),*** and with it weed roots, and its stand provides additional resistance to movement in the soil [1].

Considering the working body described above, it can be established that a duckfoot with a sharp toe in the first approximation is like two triangular wedges set at an angle ***(γ)*** to the direction of movement in the plan with a common edge inclined to the horizon at an angle ***(β).***

The longitudinal component P_x of the duckfoot traction resistance can be expressed by the following relationship:

$$P_x = R_l + R_c \tag{1}$$

Where: R_l - soil resistance to paw movement;

R_c - soil resistance to the movement of the rack.

To determine the longitudinal component of the traction resistance of one of the paw wings, we will use the formula of G.N.Sineokov:

$$P_x = R_{Bx} + R_{gx} + R_{Gx} + R_{fx} \tag{2}$$

Where:

R_{BX} - soil resistance to blade penetration;

R_{gx} - soil resistance to deformation;

R_{GX} -resistance of the triangular wedge due to the formation weight;

R_{fx} - resistance of the triangular wedge due to the inertial force of the formation.

Since the resistance to the penetration of a sharp blade during operation of the wedge in the soil cannot be determined either by calculation or experimentally, it can be included in the resistance of the soil to deformation. The force R_{gx} periodically changes from zero to a certain maximum value, which is due to the cyclical nature of soil deformation under the influence of a wedge. It can be determined by making the assumption that it is, i.e. the force $R_{gx}$is proportional to the cross-sectional area of the formation, i.e.

$$R_{gx} = K_g \cdot H \cdot B_l \tag{3}$$

Where:

K_g is a coefficient that takes into account the properties of the soil and the geometric shape of the wedge.

According to G.N.Sineokov's traction resistance of the trihedral wedge, due to the weight of the formation, according to the scheme of the effect of forces on it, is represented in the following form (Fig. 2)

$$R_{Gx} = HB_л/\rho\ g\,\frac{\sin\beta + f(\cos\gamma ctg\gamma + \sin\gamma + \cos\beta)}{\cos\beta - f\sin\gamma\sin\beta} \tag{4}$$

and

$$R_{Fx} = \frac{HB_л\rho V_п^2 sin^2\gamma[\sin\beta + f\sin\gamma(ctg^2\gamma + \cos\beta)]}{(ctg\beta - f\sin\gamma)} \tag{5}$$

Where:

l – length of the working surface of the wedge;

ρ – density of the soil;

β – paw crumbling angle;

γ – opening angle of the paw wings;

f – coefficient of friction of the soil against the working surface;

g – acceleration of gravity;

V_p – speed of movement of the wedge.

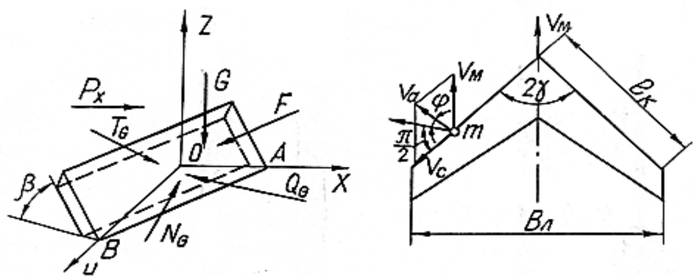

Fig. 2. Schemes of the action of forces on a triangular wedge (a) and the direction of the velocities of the points of the paw (b):

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G-formation weight; ***F*** - inertia force of the formation; N_G-normal response of the wedge to the weight of the formation; T_G-tangential force from the action of the formation weight; V_a- absolute speed of movement of soil particles along the surface of the paw; Q_G- wedge resistance due to formation weight

Taking into account formulas (3), (4) and (5), equation (2) can be rewritten in the following form:

$$P_x = K_g H B_l + H B_l / p \ g \frac{\sin\beta + f(\cos\gamma ctg\gamma + \sin\gamma + \cos\beta)}{\cos\beta - f\sin\gamma\sin\beta} + \frac{HB_{л} p V_{п}^2 sin^2\gamma[\sin\beta + f\sin\gamma(ctg^2\gamma + \cos\beta)]}{(ctg\beta - f\sin\gamma)} \quad (6)$$

The stand of the working body interacts with the destructible toe of the flat-cutting share and pushes the soil to the sides. The force of soil resistance to the movement of the rack is determined by the diagram (Fig. 3.) and on the basis of known works.

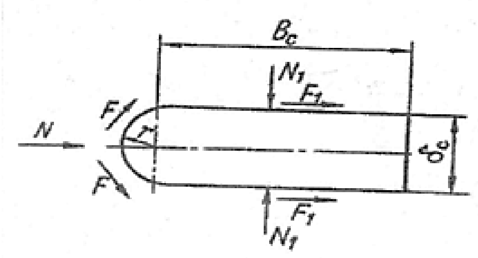

Fig. 3. Diagram of the forces acting on the rack

$$R_c = q_l H d(1+f) + 2 q_b B_c H \quad (7)$$

Where:

q_l- specific soil pressure on the frontal surface of the rack;

q_b - specific soil pressure on the lateral surface of the rack;

d = d - diameter of the cross-section of the frontal part of the rack;

B_c- width of the side edge of the rack.

IV. EXPERIMENTAL RESULTS

The results of the study by A.N.Zelenin show that the friction force arising on the lateral faces of the rack is up to 2% of its total traction resistance and therefore it can be excluded from consideration.

As a result, formula (7) has the following form:

$$R_c = q_{л} H d(1+f). \quad (8)$$

The specific soil pressure on the frontal surface of the rack depends on the physical and mechanical properties of the soil, the depth of the working body, the speed of its movement and other factors. The change in the specific pressure of the soil depending on the speed of movement can be expressed by the following empirical formula:

$$q_l = q_{о}(1 + K_V V_p), \quad (9)$$

Where:

q_o - soil resistivity at a speed of movement close to 1 m/s;

K_v- coefficient that takes into account the influence of the speed of movement on the specific resistance of the soil.

Substituting the values $R_l$and$R_c$and into formula (1), we obtain the total traction resistance of the track eradicator in the following form:

$$P_{К} = К_g H\mathbf{B}_l + H\,B_l/\rho \ g \frac{\sin\beta + f(\cos\gamma ctg\gamma + \sin\gamma + \cos\beta)}{\cos\beta - f\sin\gamma\sin\beta} + \frac{HB_l \rho V_l^2 sin^2\gamma[\sin\beta + f\sin\gamma(ctg^2\gamma + \cos\beta)]}{(ctg\beta - f\sin\gamma)} + q_l H d(1+f) \quad (10)$$

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The resulting formula allows you to analyze the influence of the parameters of the working body of the track eradicator on its traction resistance.

In the process of movement of the flat-cutting paw, the soil layer is exposed to the general influence of the left and right wings of the paw, which are two triangular wedges. Based on this, the term R_{gx} and R_{fx} in formula (2) to determine the total traction resistance of the legs is doubled.

Based on equation (10), it is possible to calculate the traction resistance of the track eradicator, depending on the main parameters of the flat-cutting share and its strut, the speed of the unit, the depth of loosening and the physical and mechanical properties of the soil compacted by the propellers of the tractors.

Figures (4) and (5) show the graphs of changes in the traction resistance of a flat-cutting (lancet) paw depending on the crumbling angles and mortar at speeds of 1.0; 2.0 and 3.0 m/s.

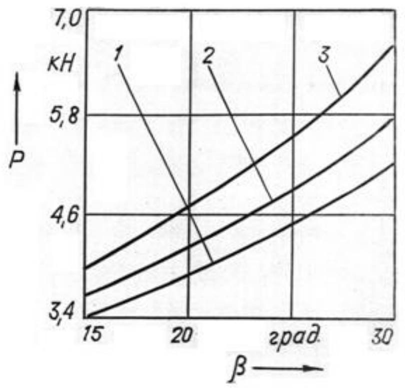

Figure: 4. Changes in the traction resistance of flat-cutting paws depending on the crumbling angle (β) 1,2,3 - respectively, at speeds of 1.0; 2.0 and 3.0 m/s

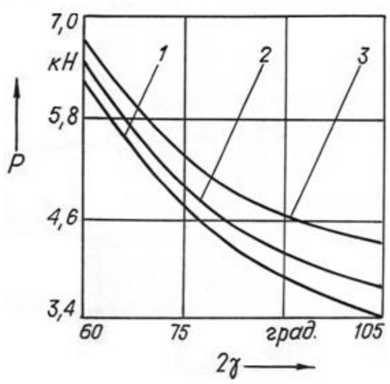

Figure: 5. Changes in the traction resistance of flat-cutting paws depending on the crumbling angle (2γ) 1,2,3, respectively, at speeds of 1.0; 2.0 and 3.0 m/s

V. CONCLUSION AND FUTURE WORK

It follows from the graph that with an increase in both the speed of movement of the unit and the angle of crumbling, the traction resistance of the flat-cutting paw increases according to the parabola law. An increase in traction resistance with an increase in the crumbling angle and speed of movement occurs due to a larger volume of deformable soil, accompanied by an increase in the normal force acting on the working surface of the paw during the compression of the soil. And with an increase in the opening angle, the traction resistance of the flat-cutting share decreases. This is due to the fact that an increase in the opening angle leads to a decrease in the area of the working surface of the paw and the weight of the soil on it, as well as the friction forces that impede the movement of the paw

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