CALCULATION OF THE RESISTANCE OF A LINEAR-STEPPING PLUG WITH A CUT SPHERICAL DISK

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Abstract: The total traction resistance of linear-step plow with truncated spherical disc was determined as the sum of the traction resistances of disc blades, housings, soil deepeners and truncated spherical discs.

Keywords: slope, cross section, spherical disk, plug, traction resistance disk blade, casings, soil dredging.

Introduction. Based on the requirements of agrotechnics, which are poured into a plough that handles sloping fields, an improved technology for plowing sloping fields against water erosion and a constructive scheme of a linear stepped plough with a cut disc that forms continuous ditches and ditches on the surface of the field were developed.Texnologiyada avval palaxsalar o‘z egati chegarasida 180°ga ag‘dariladi, shudgor tubi yo‘l-yo‘l yumshatiladi, so‘ngra shudgor yuzasida o‘rkachlar va uzlukli ariqlar hosil qilinadi, ya’ni ariqlar ichida to‘siqlar shakllantiriladi.

Analysis and results: The total resistance to traction of a cut spherical disc plow with a linear-step arrangement consists of the sum of the resistances to traction of the disc blades, bodies, soil cutters, and cut spherical discs.

$$P_{пл} = n_{\partial} R_{\partial x} + n_{к} P_{кзх} + n_{чю} R_{чю} + n_{кд} R_{кд} + Q_{x}, \qquad (1)$$

The resistance to traction of a disc blade can be determined by the following expression: [1].

$$R_{\partial x} = K_{\partial} a_{к\partial}, \qquad (2)$$

The resistance force of the support wheel is equal to:

$$QX = \mu\ QZ, \qquad (3)$$

The total drag resistance of the body with a flap is the sum of the drag resistances of the body, flap, and field boards.

$$P_{кзх} = R_{кх} + R_{зх} + F_{x} = P_{кх} + F_{x}, \qquad (4)$$

The resistance to pulling of the housing with a seal consists of the sum of the resistance to pulling of the housing and the seals, that is,

$$P_{\kappa x} = R_{\kappa x} + R_{з x}. \tag{5}$$

We determine the resistance of the body to traction using the following known expression:

$$R_{\kappa x} = \eta K a_{\kappa} b_{\kappa}, \tag{6}$$

Y.P.Lobachevsky, V.V.Sharov and S.A.According to the experimental studies conducted by Zolotarev, the resistance of the plow to traction is 20-24% of the resistance of the plow body [2, 3, 4], that is

$$R_{з x} = (0{,}2 - 0{,}24) P_{\kappa x}, \tag{7}$$

$$R_{\kappa x} = (0{,}76 - 0{,}8) P_{\kappa x}. \tag{8}$$

We accept the above.

$$R_{\kappa x} = \frac{\eta K a_{\kappa} b_{\kappa}}{0{,}8}, \tag{9}$$

$$R_{з x} = \frac{1}{4} \eta K a_{\kappa} b_{\kappa}, \tag{10}$$

We determine the transverse components of the reaction forces acting on the body and the plunger using the following expressions [5].

$$R_{з y} = R_{з x} ctg(\gamma_{з} + \varphi), \tag{11}$$

$$R_{\kappa y} = R_{\kappa x} ctg(\gamma + \varphi), \tag{12}$$

The longitudinal and transverse components of the reaction forces acting on the field board can be determined by the following expressions [1, 5].

$$F_{y} = R_{\kappa y} - R_{з y}, \tag{13}$$

$$F_{x} = fF_{y} = f(R_{\kappa y} - R_{з y}). \tag{14}$$

Substituting the values of Rky and Rzy into expressions (11) and (12) into expression (13), we obtain the following expression to determine Fx

$$F_{x} = f \eta K a_{\kappa} b_{\kappa} [ctg(\gamma + \varphi) + \frac{1}{4} ctg(\gamma_{з} + \varphi)]. \tag{15}$$

Substituting the values of Rkx and Fx into expression (15) according to (13) and (14), we obtain the following expression to determine the total drag resistance of a single-cylinder housing Rkx:

$$P_{\kappa з x} = \frac{\eta K a_{\kappa} b_{\kappa}}{0{,}8} + f \eta K a_{\kappa} b_{\kappa} [ctg(\gamma + \varphi) + \frac{1}{4} ctg(\gamma_{з} + \varphi)]. \tag{16}$$

V. To determine the pulling resistance of the soil loosener.P.We use Goryachkin's rational formula [6].

$$R_{чю} = F(K_ч + \varepsilon_ч V_п^2), \qquad (17)$$

Based on Figure 1

$$F = a_ю b_и + a_ю^2 ctg\,\psi, \qquad (18)$$

Substituting the value of F into (19) from (18), we get

$$R_{чю} = (a_ю b_и + a_ю^2 ctg\,\psi)(K_ч + \varepsilon_ч V_п^2). \qquad (19)$$

V. To determine the force of resistance to the pull of a single spherical disc. P. We use Goryachkin's rational formula [6]

$$R_{кд} = S(K_1 + \varepsilon_1 V^2), \qquad (20)$$

We substitute the value of S into expression (21) from expression (20).

$$P_{сд} = \left\{ \left(a_{кд} - \frac{D}{2}) \sqrt{a_{кд}(D - a_{кд})} \right) + \frac{D^2}{4} \left[\arcsin\left(\frac{2a_{кд}}{D} - 1 \right) + \frac{\pi}{2} \right] \right\} x$$

$$x \sin\alpha (K_1 + \varepsilon_1 V^2). \qquad (21)$$

taking aKD=0.12 M, R=0.23 m, α=30°, K1 = 0.65 kPa, ε1 = 2/102 Nc2/m4, calculations performed on the (2.58) expression showed that the drag resistance of a single disc in the speed range 1.67-2.22 m / s was 110-121 N.

Substitute the values of Rdx, Rkzx, Rchx, Rkd and Qx into (1) according to the expressions (2), (3), (16), (19) and (21).

$$P_{пл} = n_д K_д a_д + n_к \{ \frac{\eta K a_к b_к}{0{,}8} + f\eta K a_к b_к [ctg(\gamma + \varphi) +$$

$$+ \frac{1}{4} ctg(\gamma_з + \varphi)]\} + n_{чю}(a_ю b_и + a_ю^2 ctg\,\psi_1)(K_ч + \varepsilon_ч V_п^2) +$$

$$+ n_{кд} \left\{ \left(a_{кд} - \frac{D}{2} \sqrt{a_{кд}(D - a_{кд})} \right) + \frac{D^2}{4} \left[\arcsin\left(\frac{2a_{кд}}{D} - 1 \right) + \frac{\pi}{2} \right] \right\} x$$

$$x \sin\alpha (K_1 + \varepsilon_1 V^2) + \mu Q_z. \qquad (22)$$

пд=3, ад=0,11 m, Кд=0,8 kPa, пк=4, η=0,7, f=0,5, пкд=2, акд=0,12 m, R=0,23 m, α=30°, K=45 kPa, пчуи=2, аyu=0,12 m, bи=0,05 m, Кч=15 kPa, εч=8·102 Ns2/m4, K1=0,65 kPa, ε1=2·102 Ns2/m4, ак=0,24 m, bк=0,45 m, φ=25°, γ=42°, γз=30°, ψ=45°, μ=0,2 ва QZ=11 kN accepted, calculations performed on (22) expression showed that the drag resistance of a linear-wedge plug with a cross-disc in the speed range of 1.67-2.22 m/s was 24.7-24.9 kN. According to the analysis of the above expressions, the resistance to traction of the cut discs does not significantly affect the resistance to traction of the plow.

Conclusion. The results of theoretical studies conducted showed that the diameter of the cross-sectional spherical disc should be in the range of 420-490 mm, the minimum angle of the cross-sectional sector should be 42°, the depth of the sector should be 10 cm, and the angle of installation relative to the direction of movement should be 28-32°, the minimum longitudinal distance between the cross-sectional Based on the results of the calculations performed, the drag resistance of the cross-sectional spherical disc is 110-121n in the speed range of 1.67-2.22 m/s, and the total drag resistance of the cross-disc bump plug is 24.7-24.9 kN.

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