Отже, у результаті очищення моторної оливи установкою R-700 отримано освітлену оливу при застосуванні трьох із чотирьох сорбентів.

Розробка установки R-700 є складовою нашого наукового дослідження «Підвищення ефективності експлуатації сільськогосподарських машин застосуванням мобільних установок очистки моторної оливи». На наступному етапі його реалізації планується визначення хімічного складу очищеної оливи.

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JUSTIFICATION OF THE PARAMETERS OF A MINIMUM DRAFT RESISTANCE BLADE WITH FLAT FREE-ROTATING DISCS

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The process of crumbling soil with a wedge by tearing it off or shifting it is determined by the physical and mechanical properties of the soil, the angle of crumbling and the depth of cultivation.

The ploughshare used in this case is a dihedral straight flat wedge, which is characterized by the following parameters: lifting angleα and length$l_л$. The guide disks will facilitate the movement of soil along the ploughshare if the projection of their peripheral velocity onto the normal to the ploughshare is zero or directed upward. If the latter is directed downward, the discs will grab the soil and press it against the ploughshare,

which will cause an increase in the friction forces of the soil on the surface of the ploughshare and impede its movement. Therefore, in order for this phenomenon not to occur, it is necessary that the disk in relation to the ploughshare be installed in a position in which the projections of the velocities of the disk points would meet the above requirement. This requirement will be met provided [1]:

$$l_1 \geq r_d tg\alpha ,$$

where r_d – is the radius of the guide disk, *m*;

α – soil elevation angle, *deg*;

l_1 – is the distance between the disc and the ploughshare, *m*.

The parameters must be selected to ensure soil movement across the plowshare with minimal energy consumption. For the soil to move along the plowshare, the following condition must be met:

$$\alpha + \varphi \leq \frac{\pi}{2} \qquad (1)$$

where φ – is the angle of soil friction on the working surface of the ploughshare.

Considering that the friction angle φ for different soils varies from 14 to 42°, the elevation angleα, according to inequality (1), can vary within relatively large limits. Moreover, with a decrease in the elevation angle α, the length of the share l_1 increases.

Experiments conducted by M.E. Matsepuro and I.V. Manyuta, showed that when the soil is raised to a height *h*, there is a combination of the lifting angle and the length α of the share l_1, at which the resistance force of the rational lifting angle depends on the value of the friction angle [2].

The dependence of the component of the soil resistance force R_{lx} to the movement of the wedge, caused by the weight of the formation and friction forces, on the friction angle φ and the elevation angle α was established by G.N. Sineokov:

$$R_{lx} = abh\gamma_{vol} \frac{tg(\alpha + \varphi)}{\sin\alpha}, \qquad (2)$$

where R_{lx} –is the resistance force of the soil to the movement of the plowshare:

a – depth of the ploughshare, *m*;

b – ploughshare width, *m*;

γ_{vol} – volumetric weight of soil, N/m^3;

h is the height of soil lifting by a ploughshare, *m*.

To find the minimum value of the resistance force R_{lx}, we examine equation (2) for an extremum. In this case we get:

$$\frac{dR_{lx}}{d\alpha} = \frac{a \cdot b \cdot h \cdot \gamma_{об}}{\sin^2 \alpha} \left[\frac{\sin \alpha}{\cos^2 (\alpha + \varphi)} - tg(\alpha + \varphi) \cos \alpha \right] = 0.$$

After appropriate transformations we obtain the cubic equation

$$tg^3 \alpha + \frac{1}{2} \sin 2\varphi \cdot tg^2 \alpha + 2 \sin^2 \varphi \cdot tg \alpha - \frac{1}{2} \sin 2\varphi = 0.$$

As a result of solving the cubic equation using Cardano's formulas, the following expression was obtained for the extreme elevation angle α

$$\alpha = arctg \left[\begin{array}{l} \sqrt[3]{-\frac{1}{2}\sin 2\varphi \left(\frac{1}{108}\sin^2 2\varphi - \frac{1}{3}\sin^2 2\varphi - \frac{1}{2} \right) + \sqrt{\frac{1}{4}\sin^2 2\varphi \left(\frac{1}{108}\sin^2 2\varphi - \frac{1}{3}\sin^2 2\varphi - \frac{1}{2} \right)^2 + \frac{1}{27}\sin^6 \varphi \left(2 - \frac{1}{3}\cos^2 \varphi \right)^3}} + \\ + \sqrt[3]{-\frac{1}{2}\sin 2\varphi \left(\frac{1}{108}\sin^2 2\varphi - \frac{1}{3}\sin^2 2\varphi - \frac{1}{2} \right) - \sqrt{\frac{1}{4}\sin^2 2\varphi \left(\frac{1}{108}\sin^2 2\varphi - \frac{1}{3}\sin^2 2\varphi - \frac{1}{2} \right)^2 + \frac{1}{27}\sin^6 \varphi \left(2 - \frac{1}{3}\cos^2 \varphi \right)^3}} - \\ - \frac{1}{6}\sin 2\varphi \end{array} \right] \quad (3)$$

In order to determine the nature of the extremum, we find the value of the second derivative of equation (2). In this case we get:

$$\frac{d^2 R_{lx}}{d\alpha^2} = a \cdot b \cdot h \cdot \gamma_{vol} \frac{1}{\sin^4 \alpha} \cdot$$

$$\left\{ \sin^2 \alpha \left[\cos \alpha - \cos 2(\alpha + \varphi) \cdot \cos \alpha + \frac{1}{2} \sin 2(\alpha + \varphi) \cdot \sin \alpha \right] - 2 \sin \alpha \cdot \cos \alpha \left[\sin \alpha - \frac{1}{2} \sin 2(\alpha + \varphi) \cdot \cos \alpha \right] \right\}$$

Substituting the values of the elevation angle α from expression (3) into the resulting equation, we find:

$$\frac{d^2 R_{lx}}{d\alpha^2} > 0.$$

Consequently, at the values of the angle α determined by expression (3), there will be a minimum value of the ploughshare resistance. For greater clarity, the nature of the change in the extreme value of the angle α depending on the friction angle φ, expressed by equation (3), can be represented graphically (Fig. 1).

But since the friction angle φ is not constant in all areas of the field, and its average value is approximately 26°30′, the lifting angle α can be taken equal to 24-26°. The length of the ploughshare is determined by the formula:

$$l_1 = \frac{h}{\sin \alpha},$$

where l_1 – ploughshare length, *m*.

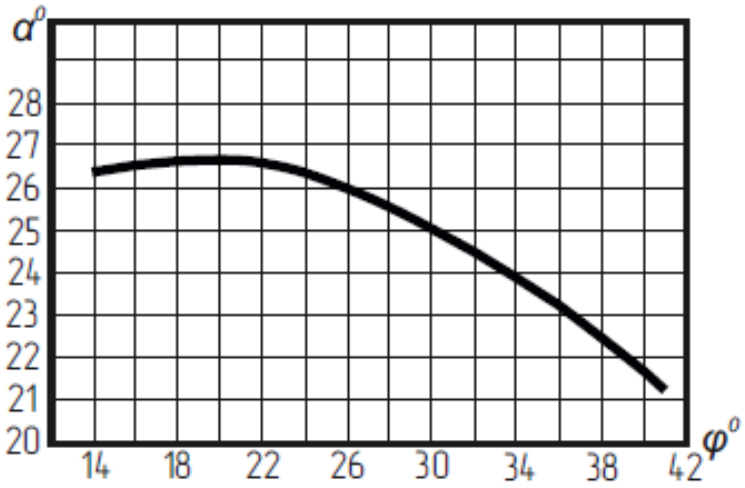

Fig. 1. The nature of the change in the extreme value of angle α depending on the friction angle φ

Conclusion. Thus, in principle, it is possible to obtain for each value of the friction angle the values of the angle of soil lift by the ploughshare at which the resistance of the latter will be minimal.

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