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Dependence of the operating body parameters of the cleaner tray to the cross-section of the pump

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Abstract. This article discusses some theoretical issues and structural capabilities of the tray cleaner working body. The process of cutting the deposited layer with an active working body. On the significant influences of the translational working speed on the cutting process of the alluvial soil layer, as well as on the effects of the speed parameter of the working body on its energy intensity.

1. Introduction

The water economy of the republic is a complex system of irrigation serving about 4.3 million hectares of irrigated land, including more than 180,000 km of canal network, 140,000 km of collector and drainage network [1].

Currently, the length of the tray network in the Republic of Uzbekistan exceeds more than 40 thousand km. During operation, the tray network become silt up, which the capacity of the tray network decreases. Therefore, the trough network needs to clean of vegetation and sediments after the growing season. The national economic significance of solving this problem with an increase in the area of irrigated land and the length of the trough network is increasing every year, and for the reason that there are practically no specialized means of mechanizing operational work on the trough network so far.

Among the reasons that impede the use of existing mechanisms for cleaning trays, it is necessary to note the different heights of the trays above the ground. The absence of a path of movement along with the trays, the low resistance of the trays to the force effects of the working bodies in the perpendicular direction, the accuracy of manipulation of the working body is necessary in order to protect the section deformation trays, etc.

The purpose of the research is to analyze and search for solutions to improve the performance of the tray cleaner when cleaning channels of reclamation systems [2].

2. Materials and methods

When examining trough sprinklers, it found that the specific volume of alluvial soil ranges from 0.12 to 0.25 m^3 / r.m. One third of the trays in the Tashkent region must cleaned periodically in 1.5 ... 2 years once.

3. Results of research

For the criterion of siltation of the trays, takes the average specific volume of sediment according to table. 1.

Table 1. Average specific sediment volume in the trough network

Trays silting category	Tray	
	LR-80	LR-100
I	0.002	0.005
II	0.018	0.015
III	0.049	0.06
IV	0.175	0.251

The design capabilities of the working body of the chute cleaner are such that the cross-section of the shave cut differently in size, depending on the thickness of the silting layer, but the segment is the same in shape [5].

The chip area is determined as follows (Fig. 1).

The area of the sector (a about in n) is found by the formula

$$S_{\sec} = \frac{R^{2as} \cdot \pi}{360^o} \quad (1)$$

where, n=120^0– arc of a sector of a circle inscribed in an equilateral triangle Δ A B C.

Area of a triangle Δ аов equal to

$$Sin_{\Delta aoв} = \frac{1}{2} R^2 Sin\, n \quad (2)$$

Then the area of the segment will be

$$S_{segment} = \frac{\pi R^2 \cdot n}{360^0} - \frac{R^2 Sin\, n}{2} = \frac{R^2}{2}\left(\frac{\pi \cdot n}{180^0} - Sin \cdot n\right) \quad (3)$$

For trays LR-10 segment area S_{seg}= 0,125 m^2.
For trays LR-8 segment area S_{seg}= 0,122 m^2.
For trays LR-6 segment area S_{seg}= 0,09 m^2.
For trays LR-4 segment area S_{seg}= 0,062 m^2.

The remaining uncut part of the silting section during the cleaning work is fed into the development zone by the working body with an envious dump. Depending on the cut off silting area, the performance of the rotor-thrower changes according to the forward working speed of the machine [6].

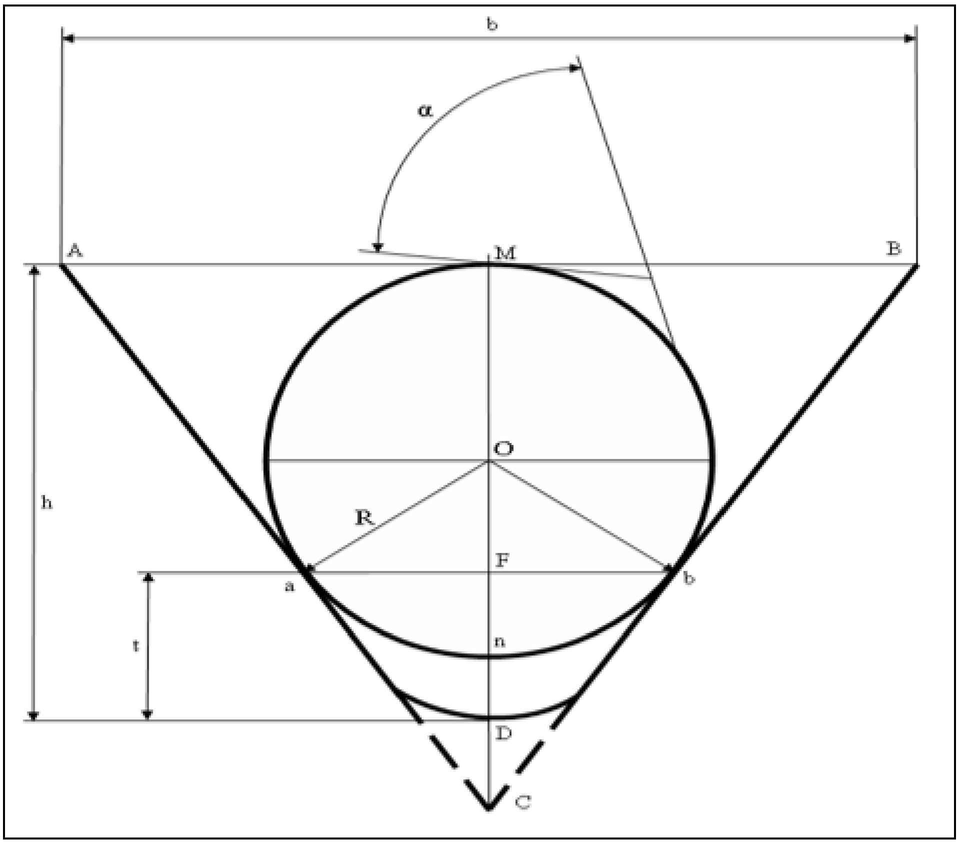

Figure 1. To the determination of the parameters of the working body of the tray cleaner

By the geometrical dimensions of the envious dump, we will determine the soil-dragging prism. To do this, we take an equivalent rectangular dump in terms of the area of the segment for each standard size of the tray. Ground drawing prism. To do this, we take an equivalent rectangular dump in terms of the area of the segment for each standard size of the tray. The soil-drawing prism (III) is determine by the formula.

$$m_p = \frac{BH^2}{2K_p} \cdot \upsilon_p \tag{4}$$

Where: B- blade width, m;

H- blade height, m;

K_p- coefficient depending on the characteristics of the soil and the shape of the dump;

υ_p- density of loosened soil for loam, kg/m^3.

Based on the minimum operating speed of the machine v_n = 360 m \ h and the rotor speed np = 300 min – 1 of the cut-out section, assuming four buckets for each standard size of the tray, the volume of the bucket will be:

LR–4 and LR-6 bucket volume will equal to V_k=350……400 sm^3

LR–8 и LR-10 bucket volume will equal to V_k=550……600 sm^3

Taking into account the cross-section of the cut-out debris and the forward operating speed of the machine, we propose a graph of the dependence of the capacity of the chute cleaner on the developed cross-section of the sediment (Fig. 2).

Analyzing the above graph, we can conclude that the silting area up to S_{seg} = 0.1 m^2 increases on average by 14% and, starting from a value above 0.1 m^2, the silting area increases by an average of 10%.

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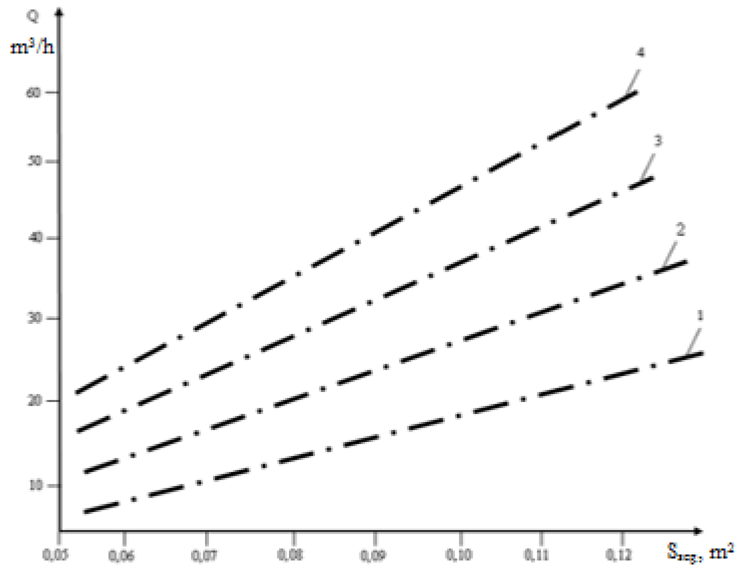
This is due to the fact with an increase in the silting area, the geometric parameters of the trays and the transporting capacity of sediment by the flow of water in the trays increase. A similar relationship observed when the capacity of the chute cleaner is increased at all operating speeds of the machine. Thus, it can be stated that the increase [7].



1 – V = 100 m/hour; 2 – V = 200 m/hour;

3 – V = 300 m/hour; 4 – V = m/hour;

Figure 2. Dependence of the productivity of the scrubber tray on the cross-section of the developed sediment excavation

The productivity of the machine is directly proportional to the increase in the cross-sectional area of the silting at any operating speeds of the machine.

To determine the capacity of the chute cleaner in m^3 / h, offer the following empirical formula.

$$Q = nV_nS \tag{5}$$

Where n– numerical value for the next working speed of the tray cleaner

V_n=100– initial working speed of the tray cleaner, m/hour;

S– cross-section of sediment siltation in the tray, m^2.

The process of cutting the deposited layer by the active working body is significantly influence by the translational working speed of the machine. v_n on which the thickness of the chips t and the feed per revolution of the rotor depend –$S_{rotation}$. Depending on the rotor speed, at a constant forward speed of the tray cleaner and the thickness of the cut chips (section of the recess), the energy consumption of the cutting process and the specific productivity of the tray cleaner change [4].

According to graphic (figure 3) possible to indicate that in rising of rotation frequency of rotor does not have value effect to effective work. Such a phenomenon explained by the fact that the cut off shavings of sediment soil with a thickness equal to the forward speed of the cleaning tray per second begins to crush by the cutting elements of the rotor, the soil is dispers and a drag prism is formed. With a decrease in the rotor speed to n = 200 min – 1, the specific productivity, depending on the thickness of the cut chips (cut section), will be 2 ... 3.2 m^3 / kWh. These values can be consider optimal.

The energy intensity of the soil cutting process is also affect to the speed parameter of the working body. This coefficient characterizes the ratio between the peripheral and translational speeds of the working body and is determined by the formula:

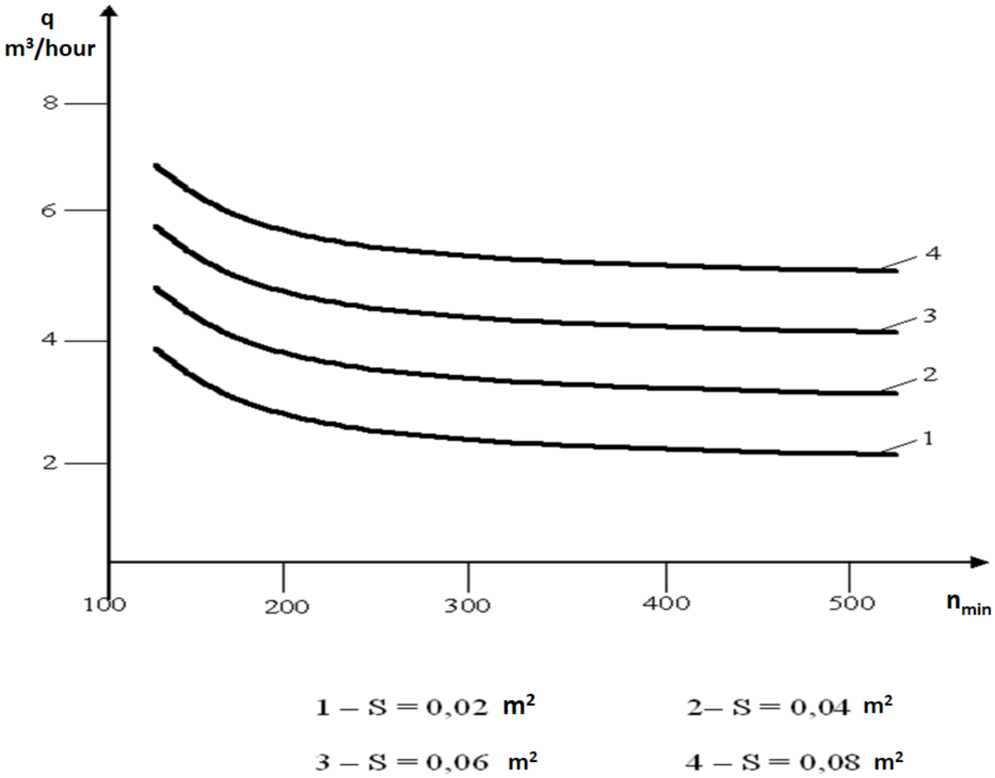


Figure 3. Dependences of the specific productivity of the tray cleaner on the speed of the rotor – thrower.

$$\lambda = \frac{\upsilon_n}{\upsilon_{o\kappa}} \tag{6}$$

Here; λ -speed parameter, υ_n - forward speed of the trays cleaner, м/с $\upsilon_{o\kappa}$ -speed of rotor–m/sec.

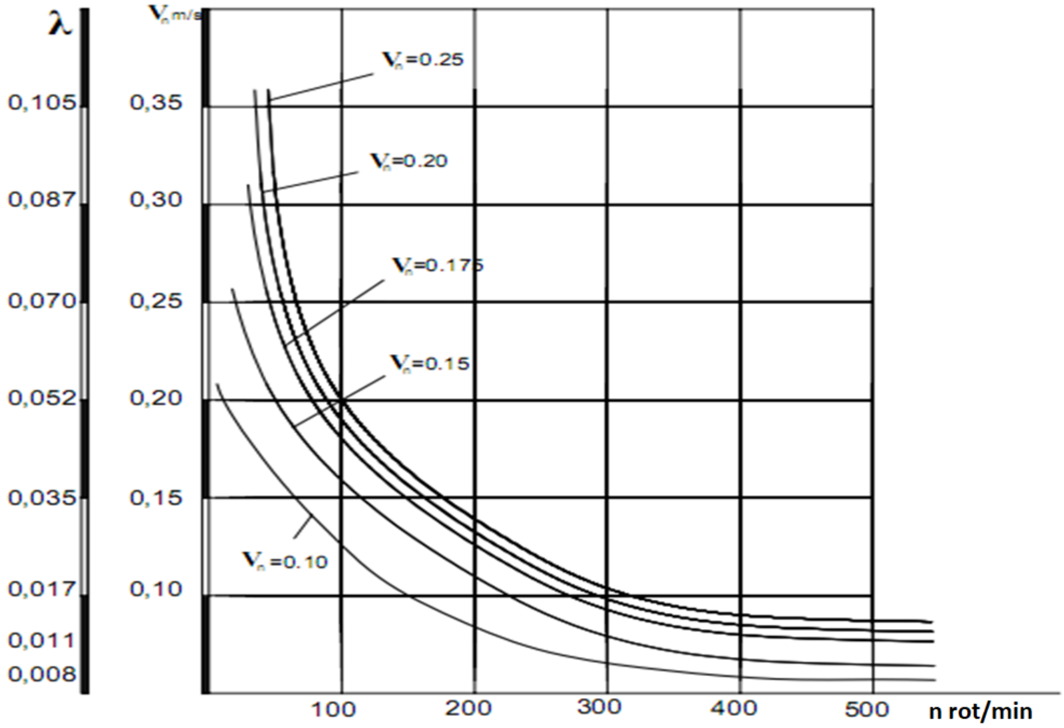


Figure 4. Dependence of the forward speed of the scraper from the speed of the rotor – thrower.

Taking into account the ratio between the values λ and S of the feed to the rotor bucket, Z of the number of buckets, ν_n and ν_{ok} shows the dependence of the translational speed of the cleaner tray on the rotational speed of the rotor-thrower (Figure 4) [9-10].

4. Conclusion

Dependence of the translational speed of the cleaner tray on the rotational speed of the rotor-thrower, **1)** that to ensure the range of soil ejection from the cleaned tray ($\upsilon_{o\kappa}$=10…15 m/sec) required rotor speed n=200…300 min^{-1} and λ =0,008…0,018 ν_p=0,1…0,25 m/sec (360…900 m/hour).

2) Middle speed ν_p =0,175 m/hour (630 m/hour) correspond to the values λ=0,014…0,021; n=200…300 min^{-1}; $\upsilon_{o\kappa}$=8…12 m/sec; υ_n =630 m/hour.

It is advisable to clean the trays with the highest feed to the rotor bucket, by the value λ limited by the size of the bucket space of the rotor. The forward speed of the tray cleaner selected in such a way as to ensure the highest productivity of the required quality of work and the lowest specific energy consumption of the tray cleaning process.

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