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STUDY OF THE INFLUENCE OF THE PARAMETERS OF THE WORKING BODY ON THE PERFORMANCE OF THE EXCAVATOR

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This paper emphasizes the importance of estimating actual productivity and presents a way to achieve it. The excavator actual productivity refers to the maximum possible productivity in real construction site conditions.

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Reducing excavator energy consumption increases machine productivity in some cases without significant changes in the design of work equipment and with low material costs. This is due to the fact that the working bodies of earth-moving machines in terms of mass and cost account for a small fraction (up to about 5 %) of the total mass and cost of the machine.

In turn, the wear of the cutting tool leads to an increase in the energy intensity of the growing process by 60–100 % and a decrease in productivity by 10–40 %. This solves the problem of increasing the durability and efficiency of the bucket cutter. Rotating shovel is an urgent matter. Increasing the wear resistance of the cutting tools (bucket, teeth, knives, etc.) of the tiller will increase labor productivity by reducing machine downtime and reducing work costs. The expensive working parts of tillage machinery still do not meet modern requirements for durability, which inevitably affects the productivity and labor cost of these machines. Finding structural solutions is very important,

The paper describes the relevance of increasing the productivity of a bucket wheel excavator. A mathematical model of the process of digging with a spherical bucket is proposed, and assumptions are made to it. The dependencies for finding the parameters of the mathematical model are described.

For this purpose special form of bucket shall be used. Thin, but increasing of radius and height makes it possible to increase the bucket volume. A spherical cap is a portion of a sphere obtained when the sphere is cut by a plane. For a sphere, if the

following are given: height h of the spherical cap and radius R of the sphere (Tab. 1), then its volume can be given by formula

$$V = \pi \cdot h^2 \cdot \left(R - \frac{1}{3} h \right).$$

Table 1

Parameters data of spherical bucket wheel rotary excavator (the effect of the values of radius and height on capacity)

Volume and surface area of spherical cap		Radius of a spherical segment (R.m)							
		0.3	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**
Height of a spherical segment (h.m)	**0.3**	0.05	0.08	0.11	0.14	0.16	0.19	0.22	0.25
	0.4	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.43
	0.5	0.10	0.18	0.26	0.34	0.41	0.49	0.57	0.65
	0.6	0.11	0.22	0.33	0.45	0.65	0.67	0.79	0.90
	0.7	0.10	0.25	0.41	0.56	0.71	0.87	1.02	1.18
	0.8	0.06	0.26	0.46	0.67	0.87	1.07	1.27	1.47
	0.9	0	0.25	0.50	0.76	1.01	1.27	1.52	1.78
	1	–0.10	0.20	0.52	0.83	1.15	1.46	1.7	2.09

The productivity of machines is primarily determined by the size and speed of movement of their working bodies and the strength of the developed or compacted soils, which in turn determines the size, weight and power of the machines. She is in largely depends capacity of bucket, number of buckets, rotor speed, technology and organization of excavation of the quality indicators of machines, the system of their operation and repair, as well as on the qualifications of drivers.

Technical productivity *Qt* (m^3/h) for bucket-wheel excavators is determined by the following formula [1]:

$$Qt = 60qzn\, K_p / K_n$$

where q — the capacity of one bucket, z is the number of buckets in the rotor, n — is the speed of the rotor, K_p — coefficient loosening of the rock in the bucket of the excavator, K_n — is the filling factor of the rotor buckets (Tab. 2).

Some of the excavator models commonly used in construction sites are defined with their technical specifications. Then, through the characteristics of each rotary excavator. We will try to identifying the parameters that help to increase the productivity and performance of rotary excavator (Fig. 1).

Tab1e 2

Parameters data of bucket wheel rotary excavator

Rotary excavator No	Capacity of one bucket of its rotor (q, m^3)	Number of bucket in the rotor (Z)	The rotor speed (n) m/s	Soil losening coefficient (Kp)	The filling factor of the rotor buckets (Kn)	Perfor-mance of continuous excavators (n_p)
1	**1.27**	8	2	1	0,89	**1369**
2	**1.52**	12	2,5	1	0,89	**3074**
3	**1.78**	16	3	1	0,89	**5760**
4	**2.09**	24	3,5	1	0,89	**11835**

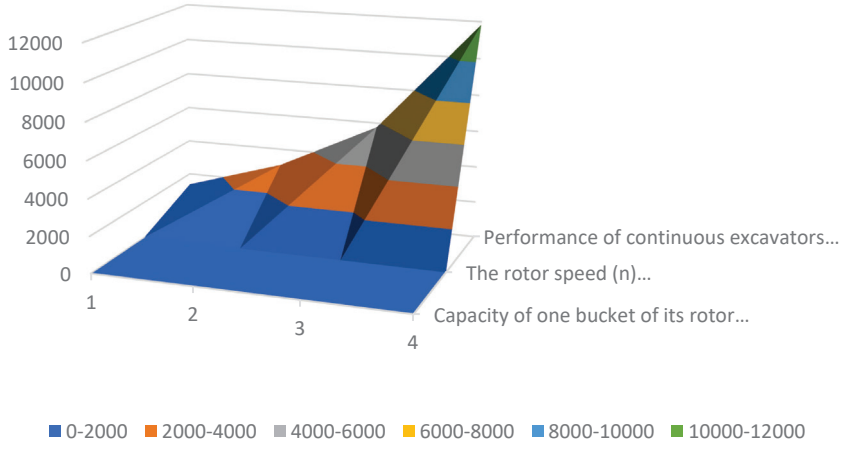

Fig. 1. The dependence of the performance of a bucket wheel excavator on rotor speed and capacity of one bucket

When the soil is transported over distances exceeding the capabilities of the working equipment of excavators, a set of machines is used that are selected taking into account the capacity of the excavator bucket.For the normal operation of the excavator, a bucket with an optimal capacity is required. The volume of soil in the bucket depends on the volumetric mass of the soil and the filling factor of the bucket.

In general, an increase in the productivity of a bucket wheel excavator can be achieved by increasing the number of buckets, but this is not entirely true. The closer the buckets are to each other, the lower their practical capacity, which is caused by a change in the angle of penetration of the bucket teeth into the soil.

In addition, an increase in the number of buckets leads to an increase in the overall dimensions of the rotor. Another way to increase productivity is to increase the size of the bucket, however, this method is also characterized by an increase in the

load on the power structure and drive of the rotary excavator, due to the increased mass of the bucket itself and the scooped rock.

With an increase in the size of the working bodies without the use of intensification of work processes, the load on the machine increases. As a result, such ways of increasing specific productivity require increasing the speed of rotor and the Vehicle travel speed.

It can be concluded that bucket wheel excavators are powerful and modern equipment, without which it is impossible to carry out quarry, mining and construction work. And to improve its energy efficiency and productivity, it is necessary to choose the optimal ratio of the number of buckets, the speed of their movement.

The bucket is the main working attachment of an excavator, and its role in the construction process is very high. Therefore to make the excavator performance efficient, it is necessary to select attachments in compliance with the demands and operating conditions.

The main parameter of a bucket is its volume as it has a direct impact on the special machine efficiency. Today it is possible to increase the bucket capacity without increasing its weight and thus overloading the excavator.

It was found that the increased productivity of rotary excavators is caused by the number of buckets, the capacity of one bucket, the speed of the rotor. All these factors affect productivity in varying proportions.

There are various factors that affect efficiency of the excavator and speed of the excavation. Factors such as bucket volume of the excavator, bucket fill rate, cycle time, swing angle, type of excavated ground, as well as environment and weather conditions influence the performance of the excavators.

References

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