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RATIONALE FOR THE APPLICATION OF A SYSTEM APPROACH IN RESEARCH

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Annotation: Machines for soil development, incl. and single-bucket excavators are one of the main types of equipment used in mining, production of building materials, in the coal industry, etc.

Key words: soil, building, mining, excavators, machines.

Introduction

Machines for soil development, incl. and single-bucket excavators are one of the main types of equipment used in mining, production of building materials, in the coal industry, etc.

Excavation work is an important part of the construction of engineering structures. Depending on the type of facility being constructed, their share ranges from 3-5 to 80-90% of the total volume of construction work [10].

In construction, the operation of single-bucket excavators and transport vehicles is limited by the timing of preparatory work and the costs of carrying out these works.

$$3_{pr}=C_{m.h}\text{-}QP_e. \qquad (1)$$

where 3_{pr} - reduced costs for operating the machine

$C_{m.h.}$ - cost per hour of machine operation.

where Q - scope of work on site,

P_e - hourly machine output.

Reducing construction costs and terms is very important in modern economic conditions. However, in numerous literatures devoted to the study of the functioning of single-bucket excavators, the main indicators that determine operating conditions include the physical, mechanical and strength properties of the soil (type, adhesion, friction angle); parameters that determine the terrain and construction site (scope of work, distance of soil transportation), etc.

In this regard, to improve the operating efficiency of excavators, in particular to increase their productivity, these works explore issues aimed at:

- increasing q (improving the design of the bucket, using grips, technological methods that help increase the loading of the bucket, measures aimed at reducing soil resistance to digging, etc.),

- reduction of TC (improvement of working equipment, lever system, increase in excavator power, which helps to increase the speed of operations) [9].

Analyzing the models for describing the operation of a single-bucket excavator presented in Chapter 1, it can be noted that they correspond to the operation of the excavator in a closed "excavator-soil" system, i.e. when the soil goes into a dump (when digging a trench, when constructing a roadbed, etc.). But if an excavator or several excavators work in a quarry together with vehicles, their work can be considered as many elements that are in relationships and connections with each other, forming a certain integrity, unity, i.e. as a system [8]. Obviously, the productivity of the excavator will depend on the operation of vehicles, and in the absence of such, the excavator will be forced to stand idle, while its productivity will be zero.

To the greatest extent, the requirements for research are met by a systems approach, which is based on the consideration of research objects as systems, which helps to identify diverse types of connections in systems and reduce them into a single theory [9, 10].

A systematic approach to solving the problem of describing the interaction of single-bucket excavators and vehicles means considering the interrelations of all elements of the "excavator - transport vehicles" system, studying its individual types as structural parts of a more complex system, identifying the role of each of them in the overall process of functioning of excavators and transport vehicles. That is, presenting the object of study as a system allows us to consider each class as a subsystem built into a hierarchically ordered structure for controlling the process of interaction between excavators and transport vehicles [7].

Knowing the composition of the system, its connections with the external environment and the relationships within the system (initial conditions), it is possible to create a description of the functioning of the system [6].

Thus, when describing the process of interaction between excavators and transport vehicles, when organizing, planning and managing their work, a systematic approach is needed that allows us to consider the work of an excavator not in isolation, but within the framework of a single transport and technological process.

The two named aspects of the system - a set of objects and a set of relationships with some characteristic features - are two obvious grounds for classifying systems [5].

According to the concept of "system", in general, a system in a group of objects, where one of the links is an excavator, should be understood as a set of real objects, including connections between them, which are used to deliver the developed "soil" to consumers.

Considering "systems" from the standpoint of organizing and managing work processes, one can notice that any of the systems, no matter what size it is, is a set of loading and unloading points, places for developing "soil" (minerals), means and means of communication, divisions of planning, analysis and management of the processes of development and delivery of “soil” to consumers.

In general, earthmoving machines with their serviced objects represent a combination of a large number of systems of various types, which in the industry are located in a certain order (hierarchy) according to attitude towards each other.

Among the most characteristic features of the hierarchical order of structures are the following:

there is an order of magnitude difference in the sizes of the characteristic elements of different levels;

- what exactly constitutes an element of a given specific level depends on the mechanism of influence that exists at this level.

For the analysis to be successful, it is necessary that the phenomenon under consideration be sufficiently isolated. For each level, it is possible to indicate suitable concepts of interaction that determine the element to be isolated for analysis [4]. From the above it follows that when developing a classification, it is necessary to consider the property of the hierarchy of systems [11].

Systems can be divided into classes according to various criteria and, depending on the problem being solved, different principles of classification can be chosen. As examples, we can point out the classification by levels of complexity by K. Boulding [2], Povorov G.N. and classification according to the complexity of behavior proposed by Fleishman B.S. [3]. In these classifications, as a rule, each subsequent class includes the previous one, and it is indicated that the same properties appear in more complex systems in a qualitatively new form. This fully applies to earth-moving machines, for example, if in the “excavator-blade” system the operational performance of the excavator completely determines the efficiency of the system, then in the “excavator-vehicles-consumer” system the operational productivity is potentially determined only by the “soil development” process and time costs for loading transport vehicles. Thus, the “excavator” element is completely included in the higher-level system, and its operational performance is accompanied by a new quality - loading. Productivity itself becomes dependent on the availability and operation of transport vehicles (cars).

Qualitative change is inherent in many indicators and therefore, at each level, as indicated in [1], new properties arise that cannot be derived as the sum of the properties of the elements.

In this case, the purpose of the classification discussed below is to limit the choice of approaches to displaying systems, to develop a description language that is most suitable for the systems considered below.

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