PREVENTING THE FAILURE OF EXCAVATOR EQUIPMENT

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Abstract. In the article, it is stated that the long-term and high-quality operation of excavators requires the right choice of technology in the organization of work, timely diagnostic work, maintenance and repair work will lead to reliable and efficient operation of the machine. The role of diagnostics in the repair of excavators and their service life have been studied. It has been determined that the productivity of excavators depends on the condition of the soil.

INTRODUCTION

The development strategy of large mining enterprises in the country is aimed at further improving product quality and competitiveness and gradually increasing production volumes. In this regard, special attention is paid to the active renewal and modernization of the fleet of mining enterprises and the purchase of new high-capacity equipment and the effective use of existing equipment. The role of excavators is important in the extraction and loading of minerals in the fields. Analysis of the excavator fleet condition shows that the average statistical value of equipment wear by service life exceeds 70%. The average service life of excavators is 22 years. Analysis of the operation of the current fleet of quarry excavators shows that even after the service life according to the depreciation rate has been worked out, excavators continue to work effectively with a utilization factor of up to 0.7. The increase in the service life of machines does not have a significant impact on the productivity of excavators, which remains at an average level of 200÷240 m^3/h when excavating rocks of category III–IV according to the scale of prof. M.M. Protodyakonov [1-3]. Maintaining the stability of technical parameters and the reliability level of the machines is facilitated by a significant safety margin of the basic units of the excavator and the unit-unit repair method, in which the main units are replaced with new or completely restored ones. The considered factors of operation on the operating time of quarry excavators are presented in the diagram, Fig.1.

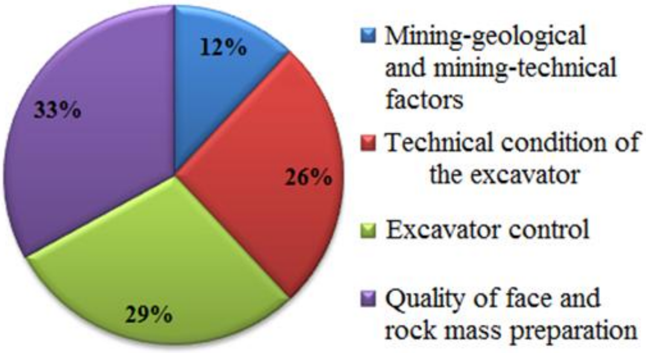

FIGURE 1. The degree of influence of operating factors on the value of operating time of quarry excavators of cyclic action

Based on the results of the analysis of the degree of influence of external conditions and internal processes on the value of operating time of quarry excavators, based on the analog-information model for assessing the value of operating time developed by the author, the following distribution of the significance of the factors considered was obtained in decreasing order of their share: quality of face and rock mass preparation (33%), excavator control (29%), technical condition of the excavator (26%) and mining and geological and mining and technical factors (12%).

EXPERIMENTAL RESEARCH

The maximum number of maintained and repair of excavators distributed types repair examination (TK), current repairs (T1, T2) and the main repair (K) are. Repairs repairman depending on the characteristics, parameters and size of the equipment, it differs by the place of transfer. Repair period - minimum of use of machines maintained and at this time as a recurring period in the sequence in which the specified types of repair are determined it is done. Up tp the first basic repair or two the time of the work the machine between the main repair and of the cycle duration constitutes the duration. Repair of machines periodicity of the parking a lot served eaten parts and details from the deadline, the duration of the stoppage to be timed the most due to the time required to complete the work determined.

Technical service and along the intersection point of these lines related types of repair year with horizontal lines required period of maintenance and repair determines. The graph of dependence of excavator performance on maintenance is presented in Fig.2.

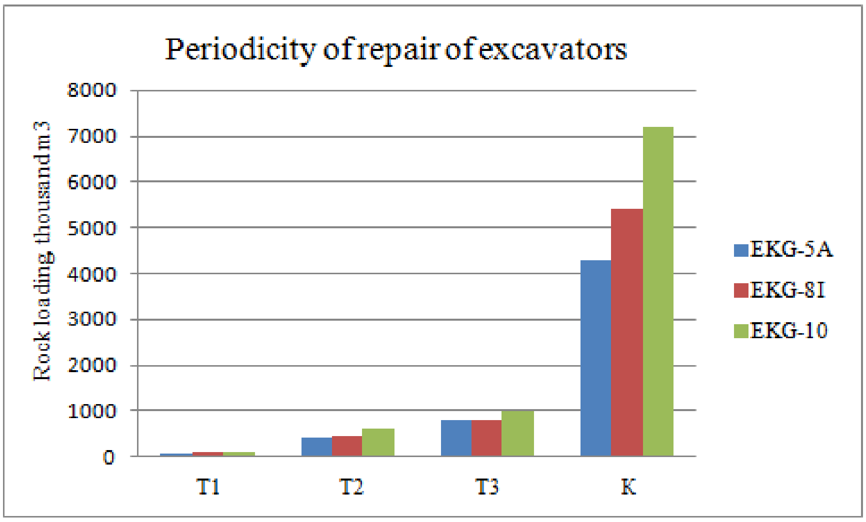

FIGURE 2. Periodicity of repair of excavators

Which is presented for excavators of this series on the basis of which the graph is drawn up, with the months along the axis of the abscissa calendar period, along the ordinate arrows, in absolute units (m^3, mash/hour and P) periodicity of maintenance and repair brought (Figure 3a.). On th axis of the abscissa obtained in Figure 3b in a horizontal position the abitility of the excavator to continuously generate a the course of the norm is listed. Keep this norm a smoothly in order to stand up for the above repair period restoration of the construction of the details using the structure listed in chart. Graphic based repair work through wasps ability to continuously presses the machine and its details using increase the working life of the excavator by increasing you can. Required number of maintenance and repair technical service along these curve intersection points and related types of repair with horizontal lines determined. The approximate duration of of the start of their transfer vertical from the intersection point to the axis of the abscissa to mark cut into strips.

Vertical lines from the intersection point to the axis of the abscissa to begin wiyh the implementation of maintenance and thev repair by dropping we find the approximate duration. From the received information using maintenance and repair annual plan it is formed. Photo in the table column «time of completion of work» appropriate type of maintenance and repair and to the max the period of their transfer is set [5-8].

The sink of the excavator is different in terms of structure and the functions of the sink distinguish the mountain rocks includes digging - loading processes.

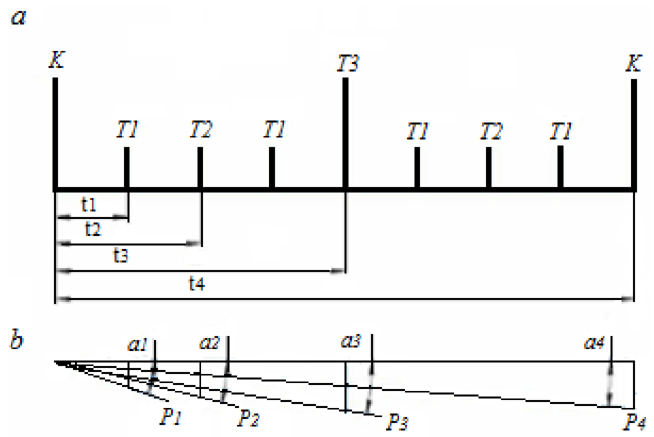

FIGURE 3. Graph of the change in the performanance of the machine
a *- the structure of the repair period,* ***b****-restoration of the achievement of the details,*
t₁ – t₄ *-time between repairs,* ***a₁-a₄*** *-direct performance capability penetration angles, respectively increase of*
P*-performance capability penetration angles, respectively increase of P-performanance ability.*

RESEARCH RESULTS

The correct choice of excavators in mining enterprises is selected depending on the geological, mining technical, physical and mechanical properties of the rock and the height of the ledge. The excavators selected in Figure 4 carry out efficient and quality assembly work in a special area. The assembled excavator performs excavation and loading operations at the quarry. As a result of the factors influencing the operation process, it affects the design, condition, performance of the excavator, so it is necessary to carry out timely maintenance and repair of equipment. The role of diagnostics in carrying out this work is great.

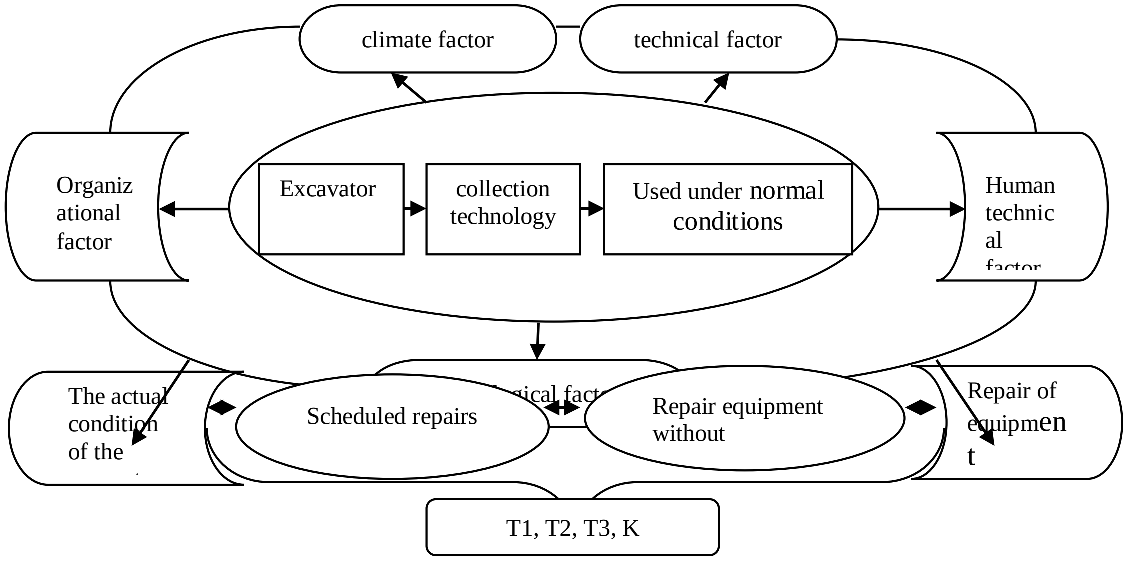

FIGURE 4. Construction of an analog model of the operating time of excavators

A necessary condition for maintenance is to keep the equipment in good condition, which in turn requires the correct use of diagnostic tools. A distinction must be made between diagnosing the technical condition of metal structures and electrical equipment. Ultrasonic, acoustic, vibrating, organoleptic, electric, electromagnetic, radioisotope, X-ray types are mainly used to diagnose the metal structures of excavators.

The purpose of diagnostics is to determine the dynamics of change of excavator equipment. The vibroacoustic method allows high-precision detection and evaluation of various defects in equipment and devices, for example, prevents the occurrence of defects in the incorrect placement, production, installation of electric motors and gearbox shafts.The magnetic method is based on the analysis of changes in the magnetic field that occur in places where defects in products made of ferromagnetic materials occur. Diagnosis using the magnetic method is inexpensive and does not require highly qualified specialists and extensive theoretical knowledge. The method of detecting magnetic defects can detect cracks, gaps, lack of penetration and delaminating to a depth of up to 10 mm with a minimum size of more than 0.1 mm. The rolling method is used to diagnose technical objects made of electrically conductive materials. Basically, the rolling method is used to detect defects located at a depth of 8 ... 10 mm; to measure the thickness of coatings; determines the physical and mechanical properties, composition and chemical composition of the object. The radiation method is based on recording and analyzing the parameters of ionizing radiation passing through the control object and determines the elemental composition, overall dimensions and internal defects of the substances. If diagnostic work is not carried out in a timely manner, it will result in some appearance of the excavator equipment shown in Figure 5.

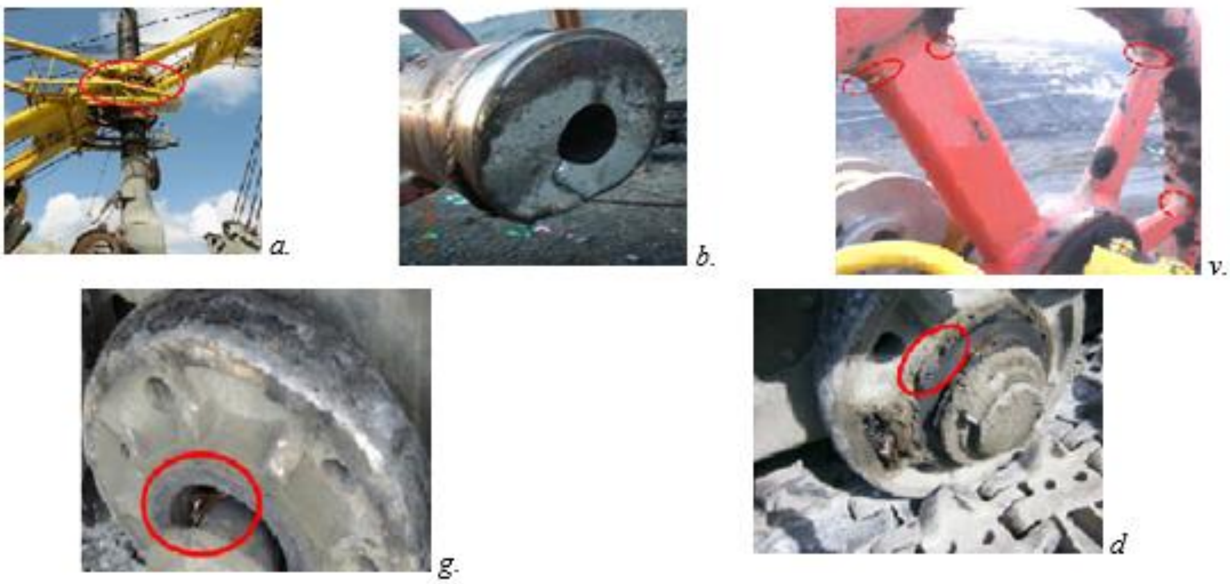

FIGURE 5. Excavator equipment: *a* – bearing of the excavaror; *b* – sedlavoy podchimnik axis; *v* – pulley; *g*, *d* – walking trails.

Figure 5a shows a saddle bearing that serves to move the bow between the excavator boom. As a result of stress on the bearing axis, over time it becomes as shown in Figure 5b. The pulleys on the saddle bearing and the rollers on the walking body will appear in Figure 5c, g, d if lubrication is not carried out in time.

The equation for changing the annual operating time of an excavator from its service life is determined by the following expression.

$$Q_{god} = [Q](-5 \cdot 10^{-4} \cdot Y^2 + 6 \cdot 10^{-4} \cdot Y + 1)$$

Q – the basic value of the annual operating time of the excavator under normal conditions. Y – the number of annual repairs of the excavator.

$$[Q] = 3600 \cdot t_s^{-1} \cdot E \cdot T \cdot K_e \cdot K_t \cdot K_n \cdot K_u \cdot K_i$$

ts - cycle time, seconds., *E* - bucket capacity, m^3., *T* - time fund, hour., Kb - excavation coefficient, *Kt* - maintenance and repair strategy coefficient, *Kn* - oversize coefficient, *Ku* - working platform slope coefficient, *Ki* - weather coefficient.

CONCLUSIONS

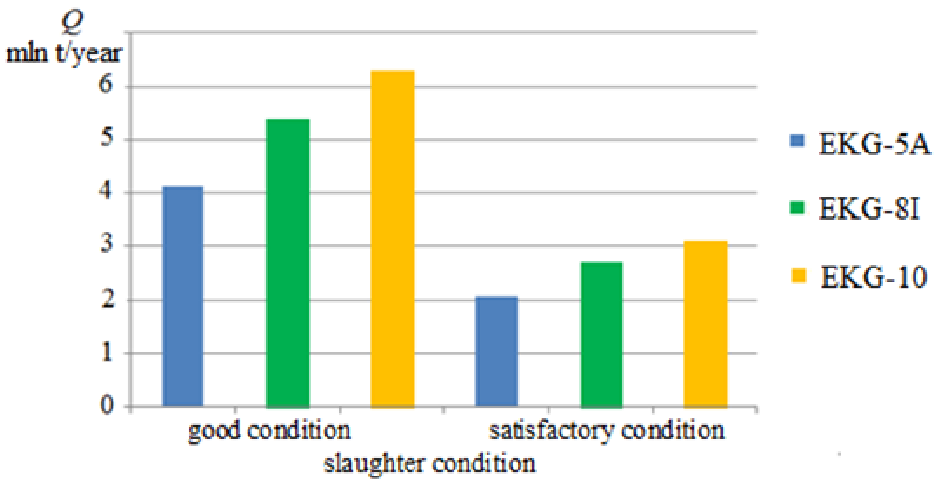

FIGURE 6. Diagram of the productivity of excavators on the condition of the slaughterhouse

In Figure 6, we can see that drilling and blasting in the quarries is carried out qualitatively and efficiently, timely cleaning of the pit with graders. The annual capacity of the EKG-10 excavator exceeds 6 million tons. This not only affects productivity, but also causes the excavator equipment to wear out quickly. Long-term and high-quality operation of excavators requires the right choice of technology in the organization of work, timely diagnostics, maintenance and repair work leads to reliable, efficient operation of the machine.

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