ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

Research of the Relationship of Technological Parameters of Extracting-loading and Automobile Complexes with Completeness of Removal of Mining Mass

Berdiyeva Dilrabo.,Subanova Zarnigar., Khakimova Dilafruz.

Assistant of the department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov, Almalyk, Uzbekistan.
Assistant of the department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov, Almalyk, Uzbekistan.
Metodist of the department faculty "Mining and metallurgy" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov, Almalyk, Uzbekistan.

ABSTRACT: This article discusses the influence of physical and mechanical properties of rocks on the need, as well as the relationship of performance indicators of mining and loading equipment with mining parameters of the rock mass.

KEY WORDS: rock excavation difficulty, physical and mechanical properties, mining and loading equipment, cohesive, loose, hard rocks.

I.INTRODUCTION

The variety of natural and mining conditions in the development of deep quarries determines the use of various options for the use of mining equipment. The engineering task in this case is the selection of equipment that is most suitable for the conditions of a particular quarry. At the same time, it should be implemented both for the technological stream as a whole, and for each technological process, in particular. Therefore, the solution of this problem begins with determining the general structure of elementary technological flows, and the basis for their formation is the combination of individual mining processes into a single technological scheme, taking into account:

- physico-mechanical properties of rocks (affect the need for and methods of preliminary preparation of rocks for excavation);
- morphological features of the structure of the field (affect the choice of methods for preliminary preparation of rocks for excavation and the actual extraction of minerals);
- consumer properties of the rock mass (affect the choice of methods for preliminary preparation of rocks for excavation, the technology of excavation, loading and transport operations and storage of rock mass);
- field parameters (affect the choice of development system, types and sizes of mining equipment).

In this master's work, questions of the influence of physical and mechanical properties of rocks that affect the need for and methods of preliminary preparation of rocks for excavation, as well as the relationship of performance indicators of mining and loading equipment with mining technical parameters of the massif, are discussed and discussed in more detail.

The influence of physical and mechanical properties of rocks on the need for preliminary preparation of rocks for excavation

Cohesive and loose, as well as hard (previously weakened) rocks, are separated from the massif by working bodies of excavation units: scrapers, bulldozers, excavators, cutting machines, combines and plow plants.

Under the influence of either static or dynamic forces, the cutting edge or tooth of the working body is embedded in the array and chips relatively small pieces (or removes chips) of the rock. This process corresponds to special mining technology parameters that characterize the rock — specific forces of cutting, spalling, penetration, etc. The main destructive stresses in this case are compressive and shear. Therefore, in the process of cutting, the main role is played by the strength and elastic properties of rocks.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

II. SIGNIFICANCE OF THE SYSTEM

When excavators are working, excavation (digging) of the rock is performed by sequential separation of chips. The excavation process includes cutting (chipping) of the rock chips and moving the cut rock over the surface of the executive body (bucket, knife, etc.). The calculated cross-sectional area of the chip is S = db, (where d is the chip thickness (depth of introduction of the actuator); b is the chip width below).

The cross-sectional shape of the chips (puncture bodies) and their actual dimensions depend on the pattern of excavation, the type and structure of the rocks

The process of excavation is usually characterized by the value of the resistivity of the rocks (rock mass) to K_F digging:

$$K_F \approx \frac{F_к}{S}, \quad (1)$$

where $F_к$ is the tangential strength of the rock resistance to dripping, N;

S is the surface area of the separation of the chips, m_2.

The specific resistance to digging depends primarily on the strength and density of the rock. When loosening loose dry sands with a mechanical shovel $K_F = (0.16 \div 0.25)\ 10^5$ Pa, for heavy wet clays $K_F = (2 \div 3)\ 10^5$ Pa, for half-breed rocks within the same structural block K_F reaches 10^6 Pa. The value of K_F depends not only on the strength of the rock in the piece, but also on the fracture of the massif, characterized by its structural attenuation coefficient k so The K_F value is affected by the type of excavation machine used and the geometry of the actuator. For example, when loam and light clays are excavated, K_F $(0.6 \div 1.3)\ 10^5$ Pa is mechanically shovel, and $K_F = (1.8 \div 4.0)\ 10^5$ Pa when excavated by rotary excavators.

To compare rocks for excavation, a relative indicator of the difficulty of excavating Pe rocks is recommended. The PE index of soft and half-breed rocks is determined by the empirical formula

$$П_{мэ} = [\ 3\ k_{с.о}\ (\ 0{,}2σ_{сж} + τ_{сдв} + σ_{р)} + 30γ]10^{-6}, \quad (2)$$

where k is the coefficient of structural weakening of the rocks of the massif in the direction of digging.

Rocks, the excavation of which is possible with existing and promising excavating machines without prior loosening, are divided into 10 classes in terms of Pe value.

The first class includes rocks in which Pe is within the range of 0-3, the second - Pe = 3÷6, etc. Breeds with Pe more than 30 are extra-categorical.

III. LITERATURE SURVEY

The largest volume of overburden operations in quarries is accounted for by the excavation of blasted rocks. Digging of the latter is usually carried out at the bottom of the face. The tangential forces and, therefore, the required efforts of the excavator depend primarily on the degree of cohesion and lumpiness of the blasted rock, as well as on the bulk density of γ rock. With a decrease in the coefficient of loosening of the destroyed rock, kp from 1.4÷1.5 to 1.05 K_F increases from $(0.5 \div 1)\ 10^5$ Pa to $(7 \div 9)\ 10^5$ Pa. With an increase in γ and the average piece size dav of the destroyed rock and collapse (at k_p = const), K_F also proportionally increases.

The relative indicator of the difficulty of excavating the destroyed Pe rocks is determined by the empirical

$$\text{formula } П^р_э = 2{,}2 \cdot A(1 + \frac{10}{к_р}), \quad (3)$$

where $A = 10^{-6}\ (γd_{ср} + 10^{-2}\ τ_{сдв})$.

d_{av} - the average size of pieces of destroyed rock in the collapse, cm;

γ - volumetric weight, kg/dm^3.

Similarly to rocks in the massif in the size of Pre, the destroyed rocks are divided into 10 classes (Table 1). On the whole, the depth of bucket penetration (scooping) z, the digging speed v_h and the scooping intensity i ($i = b_к$, where $b_к$ is the bucket width) depend on the specific resistance of the blasted rocks to digging.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

Table 1
Classification of destroyed rocks by excavation

Classes	Cr loosening coefficient at lumpiness (on dav)					Index Пэ
	0,05<	0,05-0,15	0,15-0,35	0,35-0,55	>0,55	
II	1,05-1.40 1.10-1.15 and more 1,2-1,25 and more	1,2-1,45 1,25-1,30 and more 1,35-1,50	1,3-1,50 1,35-1,40 and more 1,5-1,60	1,5-1,60 - -	- - -	Until 3
II	1,01-1,03 1,01-1,10 1,10-1,20	1,10-1,05 1,10-1,25 1,40	1,15-1,25 1,2-1,35 1,25-1,60	1,25-1,40 1,3-1,60 1,35-1,60	1,35-1,60 1,5-1,60 -	From 3 until 6
III	- 1,01-1,03 1,02-1,10	1,02-1,05 1,05-1,15 1,10-1,20	1,10-1,15 1,10-1,20 1,15-1,25	1,15-1,20 1,2-1,30 1,25-1,40	1,25-1,30 1,3-1,50 1,35-1,60	6 to 9
IV	- - 1,01-1,05	1,01-1,02 1,02-1,05 1,05-1,10	1,03-1,05 1,05-1,10 1,10-1,15	1,10-1,15 1,15-1,20 1,2-1,25	1,2-1,25 1,25-1,30 1,3-1,40	9 to12
V	- - 1,01-1,02	- 1,0-1,03 1,03-1,05	1,01-1,03 1,02-1,05 1,05-1,10	1,05-1,10 1,10-1,15 1,15-1,20	1,10-1,20 1,15-1,25 1,25-1,30	12 to 15
VI	- - 1,0-1,01	- - 1,01-1,05	- 1,01-1,03 1,03-1,10	1,03-1,05 1,05-1,12 1,10-1,15	1,05-1,15 1,15-1,20 1,2-1,25	15 to 18
VII	- - -	- - 1,0-1,03	- 1,0-1,02 1,02-1,08	1,02-1,03 1,03-1,10 1,08-1,15	1,03-1,08 1,05-1,15 1,15-1,20	18 to 21
VIII	- - -	- - -	- - 1,0-1,05	1,01-1,02 1,02-1,08 1,05-1,12	1,02-1,05 1,03-1,10 1,08-1,15	21 to 24
IX	- - -	- - -	- - 1,0-1,02	- 1,01-1,05 1,02-1,08	- 1,01-1,08 1,05-1,12	24 to 27
X	-	-	-	-	-	27 to30

Note. In each class, the first line shows the values of K_p for the destroyed dense rocks, in the second line - for the destroyed semi-rock, in the third - for the destroyed rock.

Especially low is the speed of scooping of large-blown up rock.

The scooping height hh, necessary for filling the bucket, also depends on the depth of the bucket. In this case, the minimum scooping height is hh 3bк.

Correlation of performance indicators of mining and loading equipment with mining parameters of the massif

Requirements for the parameters of individual processes of the process flow are formed on the basis of an analysis of the mining and geological characteristics of the deposit, technical conditions for the supplied mineral raw materials, the economically feasible level of losses and dilution of the mineral, as well as restrictions on the level of environmental impact of mining. For example, when preparing the ore mass for excavation, the parameters of drilling and blasting operations are determined taking into account the consumer requirements for the lumpiness and quality of the supplied ore, which imposes certain restrictions on the specific consumption of explosives and the degree of disruption of the geological structure of the massif during an explosion in order to reduce mixing of ore and host rocks. When conducting excavation and loading operations, such parameters of benches and excavation and loading equipment must be maintained that ensure the maximum yield of marketable ore of the required quality.

The formation of elementary cargo flows for each natural-technological zone and the total cargo flows of the quarry is carried out on the basis of the analysis of the geological characteristics of this zone, and the determination of their parameters is based on the design mode of mining. It should be borne in mind that if the parameters of such flows for the ore and rock zones are relatively constant in time, and their fluctuations are mainly determined by the reliability of the transport and mining and loading links, then for the ore-rock zone, the complexity of the structure of the faces

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

becomes paramount, of which the grade of the rock mass, as well as the unloading address, can change several times per shift. Therefore, in deposits with difficult natural conditions, general ore ore freight flows (commodity and off-balance) are classified as complex and are formed from heterogeneous elementary freight flows, characterized by the same variable intensity. However, at a certain stage in the formation of general quarry cargo flows, their parameters are stabilized, which under specific conditions allows using their combined varieties instead of simple ones.

After selecting mining and handling equipment, suitable types of transport are selected for it, from which the model that is most suitable for working in the conditions under consideration is determined by the same method.

Direct mechanical upper digging shovels are characterized by a high digging force of 3-5 kg/cm^2 0.3÷0.5 MPa), a large number of sizes (E = 0.25÷100 m^3 or more).

This makes it possible to effectively use them for excavating soft, dense and destroyed rocks.

($П_{мэ}$≤8, $П_{рэ}$≤10) with subsequent loading into vehicles or transshipment into the worked out space in various mountain, climatic and hydrogeological conditions. In the stopping mode, direct mechanized shovels can excavate rocks of almost any excavation. The main drawback of mehlopat is the discontinuity (cyclicity) of the working process: only 20-30% of the total cycle time is spent on the actual excavation (scooping). An increase in the power of the excavator leads to a sharp increase in its mass. The main technical and economic characteristics of excavators are presented in table 2 and.

Table 2
Main technical and economic characteristics straight shovel mining excavators

Excavatorbrand, company	Horsepower	Bucketcapacity, m^3	Weight t	DT consumption, l / h	Cost thousanddollars.
Cat 385C FSCaterpillar	530	5.7	90.6	39	1200
PC 1250LS Komatsu	651	6.5	110	59.9	1456
R 974 C Liebherr	543	4.6	84		1209
HR 40E Terex	568	6	103.6	61	1580
EX 1200-6LD Hitachi	770	6.5	108		1490

Table 3
Main technical and economic characteristics backhoeloader

Mark excavator	**Firm**	**Powerhp**	**Bucketcapacity m^3**	**Weight, t**	**DT consumption l / hour**	**Cost thousanddollars**
Cat 374 DL	Caterpillar	476	4.4	71.1		986
PC750SE-7	Komatsu	454	4	76	41.1	851
ZX670LCH	Hitachi	469	3.5	68.4		575
ZX870LCHBE-3	Hitachi	540	4.3	84.3	49	890
R 964C HDSL	Liebherr	434	3.5	75		955
Solar 500LC	Doosan, Ю.Корея	316	3.2	49.5	312	
RC-800LC-7	Hyundai Ю.Корея	510	3.4	83.3	60	800
EC700B LC	Volvo Ю.Корея	424	4.2	70	28.4*	726

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

IV. METHODOLOGY

The study of the relationship of performance indicators of mining and loading equipment with mining parameters of the massif is the basis for determining the relevant characteristics and indicators of the processes of mining. The initial data for the mathematical interpretation of such relationships with the greatest reliability can be obtained only as a result of experimental studies. In this regard, in the Muruntau quarry, which is the most characteristic among quarries with difficult mining and geological conditions, a set of such studies was carried out, the purpose of which was to establish the following relationships:

- productivity of mechanical shafts from the quality of loosening of the massif;

- the dependence of the resistivity of the destroyed rock mass to digging on the quality of loosening of the massif.

Experimental studies were carried out in the working faces with the determination of the particle size distribution by the photoplanimetric method, and the force of scooping of electric mechanical shovels was determined indirectly by the current of the bucket lifting engine with preliminary calibration with control weights. Processing the results of pilot industrial and industrial experiments under various conditions made it possible to establish the dependence of the performance of the EKG-8I excavator for 1.0 h of net working time on the average size of a piece of blasted rock mass (Fig. 1) and obtain the following analytical expression.

$$Q_{EKG-8I} = 700 - 1900d_{cp}^2 + 36d_{cp} \text{ ,} \quad (5)$$

где Q_{EKG-8I} – excavator performance EKG-8I for 1 h of pure working time, m^3/h;
d_{av} - the average size of a piece of blasted rock mass, m.

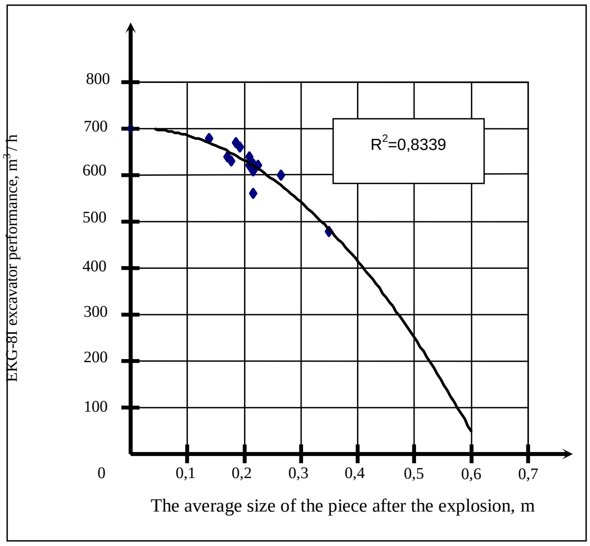

Fig. 1.Dependence of the performance of the EKG-8I excavator on the average size of a piece of rock after an

Analysis of the obtained dependence shows that as the average size of a piece of blasted rock mass increases, the performance of the EKG-8I excavator decreases and at $d_к$0.60 m its operation becomes almost impossible. This is because such a degree of crushing of hard-to-explode rocks is ensured at a specific explosive flow rate q = 0.10-0.15 kg/ m^3, which is clearly not enough for crushing rocks with the required degree of loosening of the massif.

V. EXPERIMENTAL RESULTS

The specific resistance of rocks to digging is determined for cohesive-loose (coefficient of loosening $К_р$ = 1,15; d_{cp}= 0,08-0,15 м; $\sigma_{сж}$ = 80 МПа) иосыпающегося (коэффициентразрыхления$К_р$ = 1,4; d_{cp}= 0,08-0,15 м; $\sigma_{сж}$ = 80 МПа) забоев. The experimental results (Table 3) were used to determine the relationship of the resistivity of the destroyed rocks to digging with the average size of a piece of blasted rock mass. At the same time, it was taken into

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 5 , May 2020

account that the performance of the excavator on the crumbled bottom is practically equal to its technical productivity, and on a cohesive-loose face - they served as the starting point for constructing the dependence of the resistivity of the array to digging on the average size of a piece of blasted rock mass. In this case, the relationship between the performance of the EKG-8I excavator and the average size of a piece of blasted rock mass (Fig. 4) was used in accordance with the procedure for calculating the specific resistance of rocks to digging. In the calculations, it was assumed that the drive power of the working body of the excavator is constant and fully used, and the performance of the excavator is inversely related to the specific resistance of the destroyed rock mass to digging.

Table 4
The results of determining the specific resistance of rocks to scooping excavator EKG-8I

Height filling bucket, m	Coefficient loosening array	Area shavings, m^2	Aneffort scooping kN	Specific resistance scooping, MPa	Performance excavator EKG-8I, m^3/h
6,5	0,15	0,82	144	0,13	680
8,3	1,15	0,64	102	0,11	680
6,5	1,40	1,26	138	0,12	710
8,3	1,40	1,00	100	0,10	700

VI.CONCLUSION AND FUTURE WORK

The dependence (Fig. 2) is a special case, since it is valid for a loosened massif, represented by rocks with a compressive strength of cr = 80 MPa.

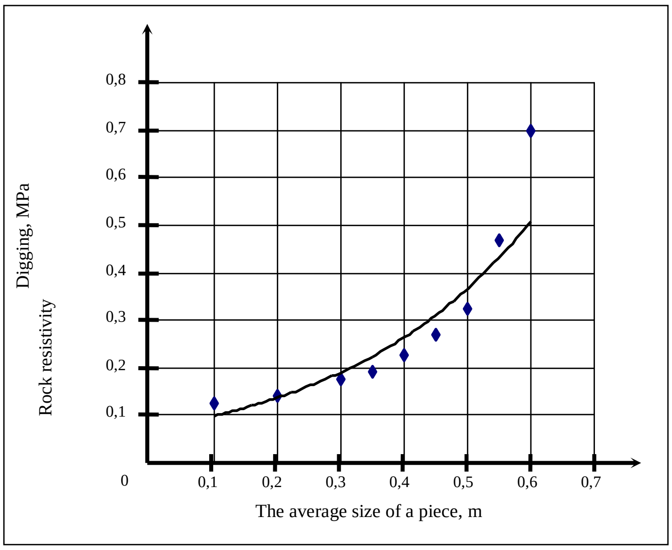

Fig.2. Dependence of the specific resistance of rocks to digging on the average size of a piece of blasted rock mass.

The study of reference data showed that, ceteris paribus, there is a direct linear relationship between the resistivity of the destroyed digging mass and the ultimate compressive strength of the rocks.

Thus, a study of the relationship between the technological parameters of mining and loading and automobile complexes with the completeness of rock extraction shows that the scooping parameters for the adopted type and model of mining machines are determined by the excavation class of the exploded rocks. The actual height of scooping of the shovel of loose and cohesive - loose rocks is less than the height of the location of its pressure shaft. As a result of experimental studies and analysis of statistical materials for mining experimental and industrial blocks in a quarry with difficult mining and geological conditions, the dependences of excavator performance and resistivity of the destroyed rock mass on digging on the physicomechanical properties of the developed massif and quantitative characteristics of its preparation for excavation and loading operations were established.

REFERENCES

1. BakhturinYu.A. The current state of open-pit transport // Catalog directory "Mining Engineering - 2005". URL: http: // probelaz.ru/ru/help/usefull/36.html (accessed: 09/21/2015).

2. BakhturinYu.A., Ph.D., Modern trends in the development of career transport. Workshop No. 16, 2009, p.403-414.

3. Melnikov NN, Kozyrev A.A., Lukichev S.V. Great depths - new technologies // Bulletin of the Kola Science Center of the Russian Academy of Sciences. - 2013. - No. 4. - S. 58–66.

4. Genike A.A., Pobedinsky G.G. Global satellite positioning systems and their application in geodesy. - M .: Kartgeocenter, 2004 .-- 343 p.

5. Novozhilov M.G., Selyanin V.G., Tren A.E. Deep careers. - M .: Gosgortekhizdat, 1962 .-- 318 p.

6. Zaripova S.N. Ensuring the safe functioning of excavator-car complexes of coal mining enterprises: abstract dis. doctor. tech. sciences. - Kemerovo, 2008 .-- 268 s