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Improvement of explosive preparation of rock mass at quarries of building materials

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Abstract— The problem of establishing a generalizing dependence of the degree of destruction of rocks in the zone of controlled crushing, taking into account the real distribution of stresses in the rock being destroyed, is solved.
Keywords: High-quality slaughtering, the use of hydrogel, and crushing of rocks, the output of oversized..

INTRODUCTION

When developing the main directions of higher use of explosion energy for crushing rocks, along with the analysis of practical data, it is necessary to take into account the main physical factors affecting the destruction of brittle bodies by explosion. However, the analysis of the process of destruction of rocks by explosion shows that, despite significant advances in this field, it is currently not yet possible to create a scientifically sound and practically proven method for calculating charges for obtaining rock mass during explosion.

The methods of calculating the parameters of the BVR, currently used [1-3], were developed in the middle of the last century. At the same time, it is assumed in advance that the parameters of drilling and blasting operations calculated according to these methods are indicative and must necessarily be adjusted based on the results of pilot explosions in specific mining and geological conditions of a particular quarry.

This circumstance leads to a significant slowdown in the forecast estimates of the results of blasting operations and the planning of the parameters of subsequent mining operations: secondary crushing, excavation of transportation, i.e. there is a significant lag in the applied theory of rock destruction by the explosion of charges of industrial explosives from the modern level and capabilities of computer technology, widely implemented in the mining industry[4].

When assessing the effectiveness of explosive crushing of rocks, the main criteria determining the effectiveness of explosive and subsequent mining operations are, the output of oversized, the degree of crushing of rocks, the form of collapse, the number of thresholds, etc., and the first two are considered to be the main ones. Establishing the general dependencies of these criteria for explosive crushing of rocks on the properties of the latter, the type of industrial explosives and the layout and initiation of charges is an almost insurmountable mathematical task.

It was established [5] that b0 is the radius of the zone of controlled crushing of rocks during an explosion

$b_0=a_{0}\sqrt{P_ж/(к_з\,\sigma_{рас})}$ м ;

where: a is the radius of the charging cavity, m; Rj is the pressure of detonation products Pa; σ is the strength limit of rocks for uniaxial tension, Pa;

$к_z=1+2\gamma\,Rj/E(1+\mu)$;

γ is an indicator of the is entropy of detonation products; E is the modulus of elasticity (Young's) of the rock, Pa; Poisson's ratio characterizing its compressibility. In turn, the Rj pressure during detonation of a cylindrical charge is determined by the ratio of the form:

$R_{j} = \Delta D^{2}/(1+\gamma)$;

where: Δ is the charge density of 1.1-1.2 kg/m3; D is the charge detonation rate, m/s. In this case, the zone of controlled crushing is approximately described by the ratio Vdr=4b02lgr, and the zone of unregulated crushing is equal to Vdr =(ab-4b20)lzr. Under the conditions of parameter $a \leq 2b_0$; $b \leq 2b_0$, there will be no oversized output, excluding the negative mutual influence of the explosion of neighboring charges on the process of destruction and rocks.

To determine the average size of a piece in a collapse, it is necessary to determine from the following properties the latest thermodynamic parameters of the explosive used, the schemes of arrangement and initiation of charges.

Table1.

№	Indicators	Units of measurement	Serial version	Pilot industrial explosion
1.	Diameter of wells	mm	110	110
2.	BB capacity 1 sh s.m. wells	kg/m	7,68	7,6
3.	Ledge height	m	13	13
4.	Grid of wells	m	3,5x3,5	3,5x3,5
5.	Bust length	m	1,8	1,45
6.	Length of the face	m	3,5	4,0
7.	Charge length	m	9,5	9
8.	Borehole length	m	13	13
9.	The mass of the charge in	kg	72,5	68,4
10.	one well			
11.	Specific consumption BB	kg/m^3	1,77	1,61
12.	Charging density	g/sm^3	1,2	1,2
13.	Oversized output	%	15	7

Parameters of blasting operations

Pilot-industrial excrement was carried out at the Vostochny quarry of Huaxincement using a hydrogel face. The destroyed rock is limestone; rock strength according to SNIP - VII- group; rock density ρbred = 2.36 103 kg / m3; fracturing is the third category of the average size of rock pieces in the mass lsr = 1m; the size of the oversized is 0.7 m. Its content in the array before the explosion is ~ 20%; the explosive is igdanite, with simultaneous detonation of 9000 kg; the number of wells in the block is 124 pieces; the exploded rock mass is 11980 tons; drilling fines and a hydrogel face are used; the method of initiating charges is non-electric- SYNS. Proposed parameters of the borehole grid for rocks of destruction

$b_0 = a_0 \sqrt{P_ж/(к_з \sigma_{рас})} = 4,0м$;

In this case, the oversized will not be formed, and the average size of the piece in the collapse will be less than with serial blasting, since it will be determined only by the average size of the pieces in the controlled crushing zone. That is, in the collapse there will be no oversized pieces available in the array before the explosion and remaining after the explosion in the unregulated crushing zone.

Fig. 1. The separation of the array after drilling and blasting

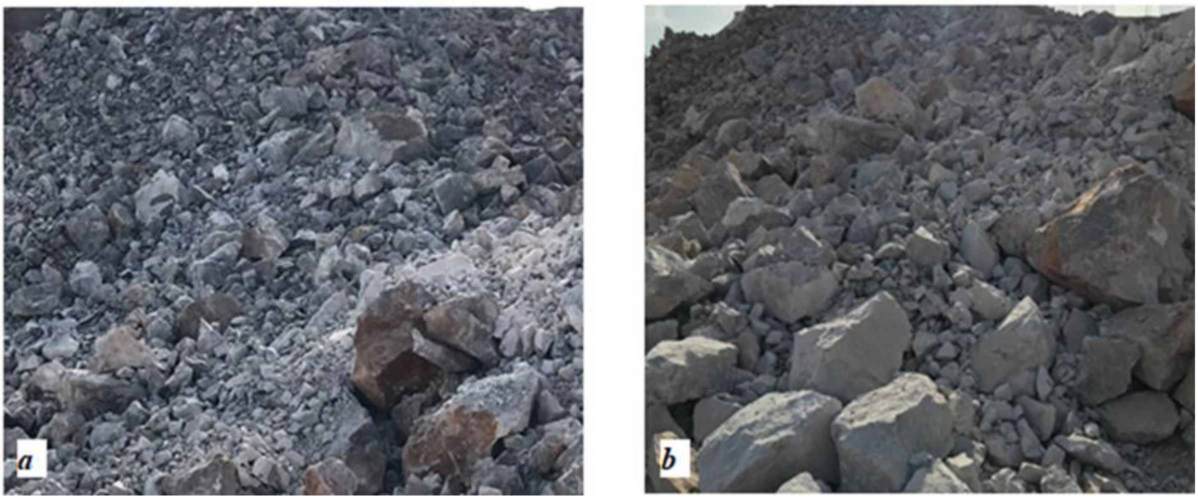

Fig. 2. Results of an experimental explosion at the Vostochny quarry:
a – after the explosion, the oversized dsr = 0.19 m using a hydrogel face; b – after the explosion, the oversized dsr = 0.24 m face using drill bits.

This assessment is almost completely consistent with the results of serial detonation. According to the proposed variant of placing charges in a pilot explosion, the output of the oversized should not be. This fact is brought (Fig.-2) at the experimental-industrial explosion which is visible, there are no oversized parts on the collapse surface. During the excavation of the oversized rock mass, no collapse was detected inside, and the average size of the pieces turned out to be equal to dsr = (0.19-0.24) m;

Thus, the experimental industrial explosion of limestone crushing at the Vostochny quarry confirmed the main provisions of the developed theory of rock crushing by the explosion of downhome charges of PVV on the ledge of the quarry.

According to the proposed parameters of the BVR, the result was explosive in collapse with a significant decrease (by 30%) in the average size of the piece to dsr = 0.19 m. With serial blasting, the output of the oversized is 15% with an average size of pieces in the collapse of dsr = 0.24m.

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