ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 12 , December 2019

Methodology for an Integrated Research of Application of the Simple Structures of Explosives in the Development of Residential Deposits

Khasanov O.A., Gaibnazarov B.A., Shamayev M.K., Melnikova T.E.

Associate lecturers and assistant of the department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov,Almalyk, Uzbekistan.

ABSTRACT: This article contains information about research on the use of the simplest explosive compositions in the development of vein deposits. The researchers conducted a series of experiments to study changes in the specific energy of charges, as well as energy indicators and the utilization rate of holes, depending on the type of explosive.

KEY WORDS: charge, borehole, explosives, potential energy of charge, hole utilization rate.

I.INTRODUCTION

When developing thin and low-power vein deposits, about 40% of ore is mined by underground mining and more than half of all precious metals in the CIS countries. Traditional vein mining technologies are characterized by low labor productivity (1.80-2.43 tons of labor / person / shift), large losses of ore and metal (up to 15%) with a high level of dilution (up to 40-75%).

Low-power vein deposits have a number of features: a complex geological structure and tectonic disturbance, an extremely uneven distribution of reserves in the bowels, limited sizes of the treatment space, and a variety of conditions for the stability of ores and host rocks. The stability of rocks is affected by the physical and mechanical properties of the ore and surrounding rocks, the variability of the shape of the topography of the roof, the angle of the vein, tectonic disturbance, etc. All this additionally complicates the development of mineral deposits.

II. SIGNIFICANCE OF THE SYSTEM

Improving the technology of excavation of low-power vein deposits is aimed mainly at reducing the volume of left pillars, reducing the cost of fixing and maintaining the developed space. When improving existing technologies, stable sizes of pillars and camera exposures, mounting parameters and other structural elements of development systems are not always justified, which makes their wider application difficult.

Therefore, the issues of finding effective and safe technologies for the development of low-power vein deposits are relevant and do not lose their significance.

III. LITERATURE SURVEY

A significant contribution was made to the development and improvement of geotechnology for the development of vein deposits: M.I. Agoshkov, Yu.P. Galchenko, N.Kh. Zagirov, B.M. Zaitsev, R.P. Koplunov, G.A. Kursakin, V.M. Lizunkin, A.I. Lyakhov, G.M. Malakhov, L.A. Mamsurov, A.F. Nazarchik, I.A. Oleinikov, D.I. Rafienko, V.D. Tamilov, A.M. Freudin et al.

Based on the experience gained and the analysis of geotechnology for veining gold ore mining, it was found that the theoretical foundations and studies of the size of the zones of destruction of the rock mass by explosion of borehole explosive charges, studies of the use of simple explosive compositions, research and the creation of new designs of blast hole explosives in the development of vein deposits have not been sufficiently studied.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 12 , December 2019

IV. METHODOLOGY

In the first stage of research, experimental work was carried out to determine the specific energy of charges of various types of explosives: igdanite, dentonite 15A10 and ammonite No. 6FW depending on its diameter.
Table 1 shows the potential energy of charges: dentonite 15A10, ammonite No. 6 FW and igdanite in bore holes of the corresponding diameters with the firing method and in table 2 the value of the potential energy of charges of dentonite 15A10 and igdanite in boreholes of various diameters with the electric method of blasting. The tables show the hole diameters of 28, 30, 32, 34, 36, 38, 40, 42, 44, and 46 mm, the diameters of the charges, the weight of the charge per 1 m of the hole, and the potential energy of the explosive charges.

Table 1
The value of the potential energy of the charges of various explosives in the bore holes of the corresponding diameters during the firing method

Diameter hole, mm	Charge diameter, mm			Charge weight per 1 m hole, g			Potential energy, charge, thousand kgm / m		
	dentonite 15A10	ammonite №6	igdanite	dentonite 15A10	ammonite №6	igdanite	dentonite 15A10	ammonite №6	igdanite
28	22	22	28	500	418	805	221	184	311
30	21	24	30	575	504	917	264	222	358
32	26	26	32	650	590	1040	311	259	405
34	28	28	34	750	682	1090	360	299	422
36	30	30	36	862	775	1210	411	341	467
38	32	32	38	990	880	1250	465	387	484
42	36	38	42	1114	1110	1390	584	488	535
46	40	40	46	1360	1380	1670	725	607	643

In the second stage, research work was carried out to determine the energy indicators of the drill holes of various explosives.
Used blast holes with a diameter of 32, 34, 38 and 42 mm. At the same time an cartridge-packed explosives , the igdanite, ammonite No. 6 FW and 15A10 dentonite with a diameter of 24, 26, 28, 32, 36, 38 and 42 mm were used. The specific heat of the explosion, the density of the explosives in the cartridge, the density of the explosives in the hole and the energy indicator of the charge at various loading factors of 0,6 and 0,9 are shown in Table 3.
In the third stage, the energy indices of blast hole charges of various types of explosives were investigated. At the same time, the diameter of the hole was taken equal to 32, 34, 36, 38 and 42 mm. The diameter of the charge was 24, 26, 28, 32, 36, and 42 mm. Various types of explosives were used: igdanite, ammonite No. 6FW and dentonite 15A10.

Table 2
The value of the potential energy of the charges of dentonite 15A10 and igdanite in bore holes of various diameters with an electric blasting method

Hole diameter, mm	Charge diameter, mm		Charge weight per 1 m hole, g		Potential energy of charge, thousand kgm / m	
	dentonite 15A10	igdanite	dentonite 15A10	igdanite	dentonite 15A10	igdanite
28	24	28	575	805	264	311

32	28	32	750	1040	360	405
36	32	36	990	1210	465	467
40	36	40	1114	1310	584	505
44	40	44	1380	1530	725	520

The specific heat of the explosion, the density of the explosives in the cartridge, the density of the explosives in the hole, the energy indicator of the charge at loading coefficients of 0,6 and 0,9 mm are given in Table 3.

Table 3
The values of the energy indicator of the borehole charges of various explosives

Diameter hole, dm	**Charge diameter, dm**	**Type of explosives**	**Specific heat explosion kcal / kg**	**Density Explosive in the cartridge, kg / dm3**	**Explosive density in borehole, kg / dm3**	**Energy indicator of charge (thousand kg / spurometer) at various loading factors K_3**	
						0,6	**0,9**
0,32	0,32	igdanite	904	1,25	1,25	243	364
	0,26	ammonite	1030	1,15	0737	153	232
	0,24	dentonite	1300	1,25	0,80	220	333
0,34	0,34	igdanite	904	1,25	1,25	268	402
	0,28	ammonite	1030	1,15	0,748	179	268
	0,28	dentonite	1300	1,25	0,815	253	371
0,38	0,38	igdanite	904	1,25	1,25	327	492
	0,32	ammonite	1030	1,15	0,775	232	345
	0,32	dentonite	1300	1,25	0,880	329	493
0,42	0,42	igdanite	904	1,25	1,25	402	601
	0,36	ammonite	1030	1,15	0,800	290	435
	0,36	dentonite	1300	1,25	0,900	440	560

At the fourth stage, the changes in the dependence of the hole utilization rate of diesel fuel in igdanite were studied (Fig. 1). In the mining literature there was evidence that the amount of diesel fuel in igdanite can be changed from 4 to 6%. The lack of data on the chemical composition of the varieties of ammonium nitrate available in the mines and changes in its properties in the manufacture of igdanite, as well as direct charging, required special industrial experiments, the optimal composition of igdanite. For this purpose, a series of explosions were carried out at the mines in sinking and cleanup faces. The diameter of the holes in both cases was adopted 40 mm. The content of combustible additives has consistently increased from 5,2 to 6,2% with constant parameters for drilling and blasting operations. Each series of explosions was repeated 3-4 times. In the process of work, the blast hole efficience ratio value was carefully measured and the quality of crushing of the rock mass was determined. Based on the results of the explosions, graphical dependences of the blast hole efficience ratio value on the content of diesel fuel in igdanite are constructed.
The graph shows that, in both tunneling and cesspools, the maximum explosion effect was achieved when the diesel fuel content in igdanite was from 5,5 to 5,8%.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 12 , December 2019

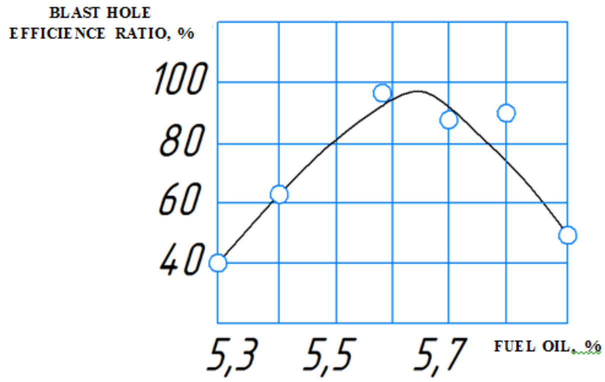

Fig. 1. The graph of the dependence of the value of blast hole efficience ratio on the content of diesel fuel in igdanite

At the fifth stage, the results of the analysis of air samples taken after explosions at the mine were investigated. Studies have established that one of the essential advantages of igdanites in comparison with other types of explosives is the reduction in the amount of toxic gases generated during the explosion. Air samples were taken at a distance of 10 m from the bottom 15 minutes after the explosion with the fans turned on. The data show that when blasting igdanite poisonous gases are formed 10-15 times less than when blasting rock ammonite No. 1. The performed studies also revealed that with the blasting of strong ores and rocks, the variety of domestic ammonium nitrate, on the basis of which it was prepared, has a decisive influence on the efficiency of igdanite.

At the sixth stage, the influence of the explosive charge energy with air gaps on ore dilution in unstable ore bodies and host rocks was studied to justify the feasibility of replacing high-sheltered blown explosives (15A10 and 10A dentonites) with medium-blast explosives (ammonite No. 6FW) with igdanite in reduced and small diameters. These studies have also been conducted in mines and sinking faces.

At the seventh stage, the work of the largest experts in explosives was studied. In these works, it was proved that the design of a charge with axial air gaps substantially affects the physical picture of the explosion and the breakdown indices; it reduces the head part of the explosion pulse and brisant action, while increasing the overall high-explosive effect of the explosion. However, in the practice of developing vein ore deposits, the study of this issue was not given due attention. The introduction of the simplest explosive compositions, their advantages in reducing the blasting effect of the explosion and improving the quality indicators of the breaking of vein ore bodies predetermined the direction of further research to find a rational charge structure and type of explosive for the conditions under consideration.

In order to determine the comparative efficiency of dispersed charges with air gaps and their influence on the quality indicators of ore breaking, research was carried out, divided into several stages. Initially, the task of the study was to establish the main parameters of the dispersed charges of high-explosive explosives (15A10 dentonite) of small diameter and to determine the rational material and shape of the disperser, as well as the maximum interval of the air gap, providing stable detonation of the charge. Over 120 series of experimental explosions were carried out.

The performed experiments allowed us to establish the following:

- stable detonation of a borehole charge is ensured by the location of air gaps in the middle of the charge, and the action cartridge in the bottom of the borehole;
- cardboard tube diffusers showed a more stable detonation transmission than wood cork dispersers;
- the maximum length of the air gap with stable detonation of 15A10 dentonite cartridges with a diameter of 24 mm was 15 cm, and with a diameter of 28 mm - 20 cm.

V. EXPERIMENTAL RESULTS

The experimental work of the authors [3] to identify the effectiveness of the dispersed charges of blasting explosives in bore holes of reduced diameter was also carried out during the breaking of fractured vein ore bodies and rocks of medium strength and above (f = 8-13). The results of the study of borehole charges of dentonite 10A of various diameters (30, 34, 38 mm) with air gaps of a hole depth of 1,6-1,7 m were subject to comparison. The boreholes were dispersed by cylindrical dispersers made of thick paper.

The results of comparative explosions showed that in stronger rocks (f = 10-13) the magnitude of the line of least resistance and the utilization rate of the hole of dispersed hole charges are reduced by 8-12% (with a maximum length of air gaps) for by reducing the potential energy of the charge. However, there is a rational length of the air gap, which

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 12 , December 2019

does not affect the magnitude of the line of least resistance and CISH. So, the use of two air gaps of 10 cm at a constant charge length provided the same value of line of least resistance and KISH. Subsequent experiments confirmed this important point for the successful construction of drill holes with air gaps of the simplest and most explosive explosives. The granulometric composition of the beaten-off ore mass when applying the design of charges with two air gaps of 10 cm is noticeably improved: the yield of fines is reduced by almost 2 times (-50 mm) and the yield of ore of medium fractions is increased 1,5-2 times. Improving the quality of ore crushing is very important when breaking a fractured and prone to caking ore mass. All experimental explosions with dispersed charges (32 series of explosions) were effective, there were no lumbago shots, which indicates the stability of detonation transmission. The conducted experimental work confirmed the feasibility of using dispersed high-shear charges in the clearing of thin veins lying in medium and higher average strength fractured rocks, which, due to the more efficient use of explosion energy, can improve the quality of ore mass crushing and reduce the specific explosive consumption by 15-20%, without reducing the productivity of workers of the slaughter.

The following studies were carried out with the aim of establishing the comparative effectiveness of various designs of igdanite charges and their influence on the quality indicators of breaking, to identify the area of practical use of the reduced igdanite charges of reduced diameter with axial air gaps.

In connection with the novelty of the questions under study and the lack of similar studies, experimental work was carried out in polygon and industrial conditions at several mines (the explosion of single and group charges).

For the reference design of the drill hole charge, a continuous core charge of igdanite was taken. For comparison, charges of ammonite No. 6 FW, dentonite and granulite AC-8 were also tested.

Of great importance are the results of polygon experiments, which made it possible to establish the practical feasibility of using cartridge igdanite with air gaps in drill holes of reduced diameter, as well as determining the minimum diameter of the charge and the maximum length of air gaps at which stable detonation of charges is guaranteed.

Igdanite charges of various diameters and designs were placed in segments of seamless steel pipes with a wall thickness of 5 mm and an inner diameter of 19, 25, 31, 37 and 50 mm. The air gap was created by introducing cardboard diffusers of the appropriate diameter into the tube. The weight of igdanite in charges was determined by weighing. The fighter cartridge weighing 75 g in all cases was made of 15A10 dentonite.

The value of the air gap varied from 5 to 50 cm, with intervals of 5 cm for charges of reduced diameter. For each diameter of the charge, the length of the air gap was tested from the minimum value (5 cm) to the value at which detonation transmission ceased. The density of igdanite in cartridges varied from 0,95 to 1,15 g / cm3.

VI. CONCLUSION

Thus, the foregoing allows us to draw the following main conclusions:

-the provision on the specific energy of explosives as the main criterion for the operation of a blast hole explosion allows one to most objectively evaluate the comparative efficiency of industrial explosives in the development of vein ore deposits;

- the energy criterion for evaluating explosives opens up additional possibilities for more accurate determination of rational energy parameters for breaking the vein mass in various mining and geological conditions and helps to improve the quality indicators of breaking the ore and gangue;
- regulation of the volume concentration of the simplest explosives is possible due to the composition and ratio of components, as well as due to the compaction of explosives in the charging cavity;
- the specific energy criterion for explosives reveals the advantages of charges of the simplest explosives of small diameters, and also makes it possible to more efficiently use the explosion energy under the considered difficult conditions of breaking the vein ore deposits;
- the massive use of the simplest explosives with mechanized loading confirms the correctness of the energy criterion for evaluating explosives, the proportionality of the explosion to the explosive charge energy reserve and the prevailing effect of volumetric energy concentration on the cost of drilling and blasting.

REFERENCES

[1] Pokrovsky G.I., Fedorov I.S. The effect of an explosion in deformable media.-M., 1957. -276 p.
[2] Rakishev B.R. Energy intensity of mechanical destruction of rocks. –Almaty: Baspager, 1998.210 s.
[3] Rodionov VN, Adushkin VV and others. The mechanical effect of an underground explosion. –M., 1971. -200 p.
[4] Rakishev B.R. Prediction of the technological parameters of blasted rocks in quarries. –Alma-Ata: Science, 1983. -240 s.
[5] Kutuzov B.N., Rubtsov V.K. Physics of explosive destruction of rocks as applied to explosive works // In coll. Blasting business. –M., 1963. -№53 / 10. –P.31-36.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 12 , December 2019

[6] Kazakov NN, Explosive breaking of ores by borehole charges. –M., 1975. -190 s.
[7] Belenko F.A. Investigation of stress fields and the process of crack formation during the explosion of column charges in rock // Problems of the theory of rock destruction under the influence of an explosion. –M., 1958. –S126-139.

AUTHOR'S BIOGRAPHY

Khasanov O.A.,lecturer of the Department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov	
Gaibnazarov B.A., lecturer of the Department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov	
Shamayev M.K., lecturer of the Department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov	
Melnikova T.E., assistant of the Department "Mining" of the Almalyk branch of the Tashkent State Technical University named after Islam Karimov,Almalyk, Uzbekistan