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RESEARCH BY ENLARGING THE DIAMETER OF CARVING SPURS

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ABSTRACT. Enlarging the diameter of a common set of Spurs or Central Spurs (up to 60-75 mm) can make it possible to reduce the intermediate distances of the Spurs in the groove. In the process of drilling Spurs with an increased diameter, it is possible to reduce their number and the distance between Spurs due to the concentration of the charge of explosives in a relatively small amount of turbulence. The additional time spent on drilling large-diameter shpurs is compensated by the preparation-to the final processes, charging, blasting and pumping air, increasing the productivity of the cycles of deep shpurs drilling processes. The use of larger diameter Spurs in the grooves is an effective means of increasing the depth of the Spurs.

Keywords. crack, tangential voltage, tangent, corrosive shpur, explosive, crush zone radius, crack formation zone radius, explosive charge, strength coefficient, shpur use coefficient, loading, blasting, ventilation, additional open surface, shpur depth, shpur diameter, lahim, specific consumption of explosive, stopper, compensation shpuri, voltage wave.

Introduction

The conditions for using this method are as follows: If different methods can be used, the rationality of using this method is determined by the rate of change in the speed of drilling large-diameter Spurs compared to small-diameter Spurs. Obviously, taking into account the decrease in the speed of drilling with an increase in the diameter of the shpur, this shpur should provide not only the replacement of small-diameter shpurs with its effect during the explosion, but also a slight saving of the drilling time due to a decrease in the number of Spurs. The correct choice of groove construction is decisive for achieving positive results in mining operations.

As you move away from the center of the explosion, the intensity of the voltages that occur under the influence of the compression wave decreases, and the crushing process acquires a different character. As a result of the impact of the compression wave, tiny particles of continue to move along the radius of the waves spreading from the center of the explosion. As a result, in the medium, each elementary spherical layer that separates from each other stretches, increasing its radius, which leads to the appearance of a system of radial cracks that diverge from the charge in all directions. In other words, the crushing of toggzhini in the zone occurs through the formation of cracks directed perpendicular to the surface of the sphere.

Let's consider the cross section of the charge located at a certain distance from the ends of the explosive charge. In this case, we consider the environment in the direction of the layer radius infinitely expanded. The solution obtained on the basis of these assumptions corresponds to the

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explosion of a sufficiently long cylindrical charge in an unlimited environment. The erosion of Rocky toggzhins can be imagined in the form that the pressure inside the cavity occurs with a gradual increase from Infinity to the axis of charge.

A rocky array can be considered an elastic medium when the pressure in the cavity is low. In this case, as the pressure increases at the gap limit, the stretching tangential and compressive radial voltages increase. When tangential voltages reach a certain threshold σ, directional cracks appear along the radius at the gap limit. The length of each individual crack will most likely be much smaller than the radius of the crack formation zone. The boundary of this zone is a necessary condition for maintaining the symmetry of the crushing zone so that the tangential voltage value of the toggzhins is determined by the tangential voltage value equal to the limit of the ripeness to the stretching voltage.

Main part

The appearance of Radial cracks will be associated with the presence of tangential voltages that exceed the crushing force of toggzhin. At a distance from the center of the camouflage explosion, deformations that occur under the influence of stretching voltages stop, and new cracks are not formed. However, cracks that have appeared earlier can spread again to a certain distance due to the redistribution of stretching voltages near their ends. The dimensions of the Radial cleavage zone depend on the cleavage of the ridges, their physico-mechanical and mining-technological properties, the transition of the energy of the explosion to the voltage wave and the time of their impact on the environment.

Such results of blasting work are explained by the fact that when designing the parameters of drilling and blasting work at the Kowuldi mine, the interaction of the main mining-geological and mining-technical factors characteristic of certain regions is not taken into account. The mechanism of crushing Rocky monolithic rocks by blasting them with a centralized charge of explosive material is fundamentally different from the mechanism of action of the explosion on an array of Earth rocks. Under the influence of a shock wave near the explosive charge in the array of Rocky Mountains and the high temperature of the explosion products, toggzhinsi is strongly deformed and a crush zone is formed (Rcr) is shown in Figure 1.

With a further increase in pressure in the cavity, the conical fragments of the ridges formed as a result of radial cracks begin to crumble. With an increase in pressure, there is an expansion of the crush zone. In addition, at the end of the crush zone, the radial voltages under one-axis compression reach a certain limit value corresponding to the compression voltage value σ. Within this zone, the toggzhins are very strongly crushed, and in their structure the particles approach the granular environment, such as compacted sand.

As the explosive moves away from the charge, the voltages in the crush wave decrease rapidly, and at a certain distance, the resistance of toggzhin to the crush is low, accordingly, the deformation property changes, which leads to a change in the crushing performance of the medium. Under the influence of a voltage wave that propagates correctly from the charge of an explosive substance, strong compressive voltages in the radial direction occur in the tighjins, and in the tangential direction, stretching voltages occur that ensure the appearance of radial cracks. As a result of such an effect, the internal structure of the binder in the toggzhins is

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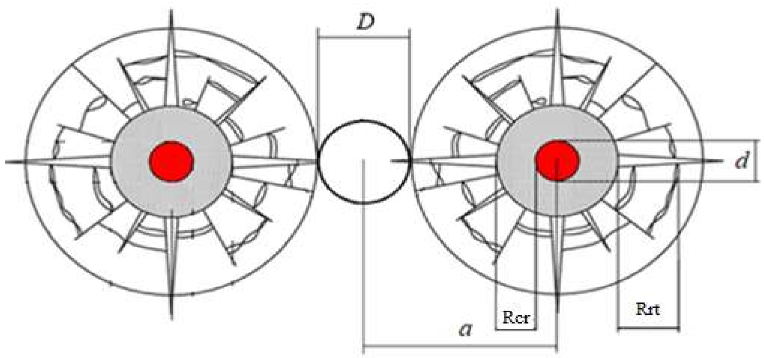
broken down, and it decomposes into separate fragments. This is due to the fact that as a result of the separation into pieces, a zone of cracked formation occurs (Rrt).



Rcr-the radius of the crushing zone, m; Rrt-the radius of the crack formation Zone, m; D – the diameter of the compensation Spurs, m; d-the diameter of the charged Spurs, m; a-the distance between the Centers of the charged and compensation Spurs, m

Figure 1. Scheme of distribution of tailings in the massif of toggzhins around the explosive charge

In layers far from the charge, the shock wave turns into an elastic wave, the voltage and tangential voltages are reduced, and less than the stretch resistance value of toggzhinin, the contact between the particles in the medium is not disturbed, only the oscillatory displacement of the particles occurs. Outside this distance, with the direct direct influence of the wave, the crushing of the toggins does not occur. Strongly compressed toggins move to the center of charge, and in the parts of the toggins adjacent to the cavity, tension increases in the radial direction, while ring-shaped tangential cracks appear in the toggins. In this, a vibration zone is formed. In this oscillation zone, we form an open surface by drilling a non-charged compensation shpur in an enlarged diameter to grind the debris with an explosive charge to the desired size.

There are no clear boundaries between the zones of crushing and crack formation. The boundaries of these zones smoothly pass into each other, and these zones form a common crushing zone. The radius of the crushing zone depends on the amount of charge of the explosive and the parameters of the explosive.

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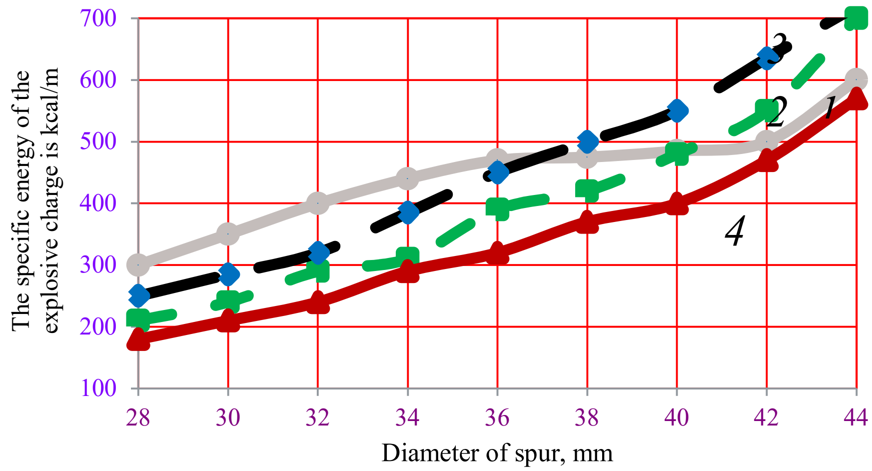
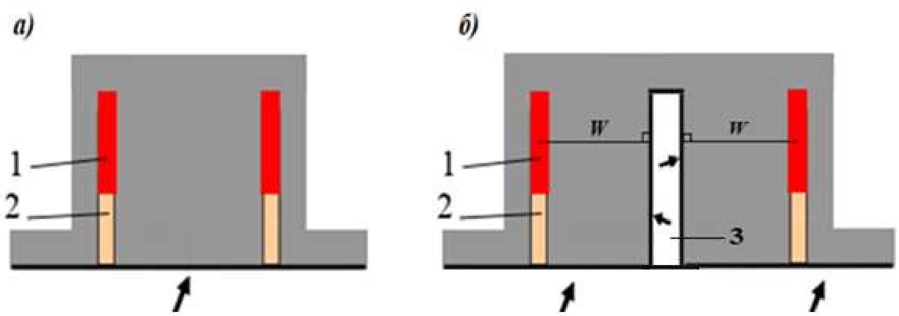


1 – Almanite blasting by fire method, 2-Ammonite No. 6JV blasting by electric method; 3-During electric blasting of almanite; 4 – Ammonite No. 6JV in fire blasting

Figure 2. Different types of explosive substance charges graph of relative energy per unit length of the sphere based on sphere diameter

Obviously, the greater the charge and its power, the greater the radius of the crushing zone. When an explosive charge explodes near an open surface, under the influence of a voltage wave that has reached this surface, particles of the medium begin to move freely towards it and contain even more distant parts of the medium in the process. With an increase in the number of open surfaces, the volume of absorption of a large array of exploding charges also increases approximately in proportion to their number. The explanation for the increase in its initial volume when the crushing of toggzhins is shifted towards the open surface is shown in Figure 3.



1-explosive charge in shpur; 2-stopper; 3-compensation shpur; ↑ - arrows indicate the number of open surfaces, pieces; W is the shortest resistance line, m

Figure 3. Schemes for placing explosive charges on shpur on one (a), two (b) open surfaces

Results and discussion

The width of the gap between the broken and unbroken parts of the array should be proportional to the shortest resistance line and the polynomial coefficient of the tangents (Km). To form an

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open surface, the required width of the cavity (according to the data of experimental-industrial tests) (1/10 ÷ 1/30) must be in the range of•W, [1].

The rational distances between the Spurs forming when crossing the shtrek under the conditions of the kowuldi mine are given in Table 1.

Table 1

Rational distances between forming Spurs, m

Explosive type	prof.M.M. Protodyakonov scale coefficient, (f)		
	10-12	12-14	14-16
Almanite	0,75 - 0,70	0,70 - 0,65	0,65 - 0,60
Ammanit 6 CV	0,85-0,80	0,80-0,75	0,75 - 0,70

The specific consumption of the explosive (kg/m^3) is shown in Table 2 for Spurs with a depth of 1.6 m and a diameter of 42 mm.

Table 2

Specific explosive consumption, kg/ m^3

Transverse cross-sectional surface of S, м^2	prof.M.M. Protodyakonov scale coefficient, (f)		
	10-12	12-14	14-16
9,0	1,84-2,16	2,16-2,63	2,63-3,0
10,5	1,78-2,09	2,09 - 2,55	2,55-2,90
12,0	1,68-1,97	1,97-2,41	2,41-2,74

Obviously, the higher the charge and its capacity, the greater the radius of the explosion effect. When an explosive charge explodes near an open surface, under the influence of a voltage wave that has reached this surface, particles of the medium begin to move freely towards it and contain even more distant parts of the medium in the process. In order for the mine sarcophagi to explode and advance to a certain specified driving distance, a complex of carved, auxiliary and forming Spurs is drilled in the underground horizontal mine sarcophagus. The location of the complex shpurs in kovjoy, its number will depend on the mining and geological characteristics of the Mountaineers and the dimensions of the sarcophagus, moreover, on the type of explosive used, the diameter and depth of the shpurs, and on the design of the charge. Of the parameters mentioned above, the main influence on the structure of the set is the depth of the Spurs. If the depth of the Spurs is taken correctly, this position will provide the kovjoy with the required pushing distance during the cycle. In contrast, when deep Spurs have been applied to the kovjoy to extend the thrust distance, the number of traversal cycles of the sarcophagi in that case decreases on the one hand, while on the other hand it also relatively reduces the time consumption that has gone into charging, blasting and ventilation. The question of the interconnection of the depth of Spurs with the specific consumption of

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detonation substances has been studied by most scientists from practical and scientific aspects [2-8].

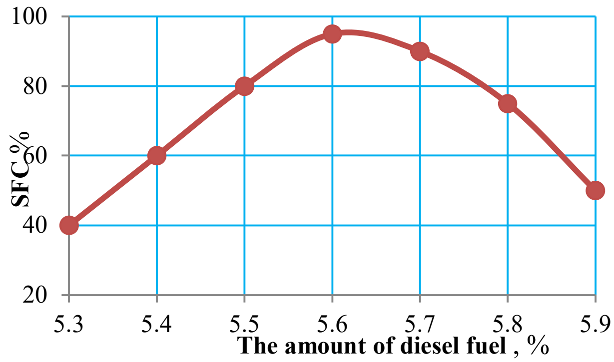

Figure 4. Dependence graph of diesel fuel with explosive substance on spur use coefficient

Under the conditions in which drilling machines with high production capacity are used, the Spurs are compared among themselves according to the following indicators: specific explosive consumption, the number of Spurs drilled and the optimal indicator of the coefficient of use of Spurs. Thus, when adopting the optimal depth of Spurs in the kit, it is necessary to take into account many factors, including their economic assessment. The most optimal variant of the selected scheme should find its confirmation according to the results of experiments carried out in practice. To do this, it will be necessary to compare as many of the Spurs complete schemes as possible, which are used today in mining practice, familiar to all specialists.

The depth of the Spurs should be taken in such a way that the specific consumption of the explosive and the number of Spurs drilled in the kovjoy should be kept to a minimum. Studies show that such a shpur depth is proportional to the groove depth in the wedge shape, and the work carried out in it can be assessed as follows.

The effectiveness of the work carried out in the process of passing the mine Wells is a direct link to the correct choice of the depth of the drilled Spurs, the charge mass and the correct location of the Spurs in the kovjoy. It is known that when blasting is carried out in a compressed environment, there is a need to increase the specific consumption of explosives [9-13].

Under such conditions, the charge placed in a parallel position relative to the open surface is the most optimal and effective. In this case, the load on the toggins along the entire length of the charge will be in one rhythm. Therefore, parallel Spurs are used in a wedge-shaped groove to form a second open surface. The carved shpurs are partially passed by deviating from the axis of the passing Lahim. If the depth of the shpur increases, the central angle of the carved shpur decreases, and the coefficient of shpur use decreases compared to the position of the charges in parallel, and the specific consumption of the explosive increases.

When the depth of the Spurs increases, it is necessary to leave the number of Spurs and the specific consumption of the explosive as before, because, on the one hand, to check the correct selection of the previous Spurs, and on the other hand, to prove the shortage of their number and the increase in the specific consumption of the explosive in conditions].

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Based on mining geological conditions, lahim dimensions and blasting conditions, the optimal angle of deviation of the carved shpurs, the minimum specific consumption of the explosive can be determined. The depth at which the minimum specific consumption of the explosive was determined was perceived in practice as the normal depth of the groove in the form of a wedge. When the dimensions of the sarcophagus are the same, but in conditions where the depth of the Spurs increases, the optimal set of drilled Spurs is carefully selected by their number, location, groove construction. With an increase in the depth of the Spurs, their number and the specific consumption of explosives should be left the same, on the one hand, to check the correctness of the choice of the number of Spurs at the bottom depth and, on the other hand, to prove the lack of the number of Spurs. It is necessary to increase the specific consumption of Spurs and explosives with an increase in their depth.

Based on the above, methods for increasing the depth of Spurs on the surface of the constant transverse section of the Lahim were selected and systematized. The method is as follows: If you increase the depth of the shpurs in the form of a simple wedge from the initial depth, leaving the type of explosives and The Shape of the shpur charge unchanged, it is necessary to increase the specific consumption of explosives to keep it constant. When a pyramid-shaped groove is mainly used, in which one or more uncharged Spurs act as an open surface and compensation area [14].

An example of this is the successful use of long Spurs when crossing sarcophagi at the Kowuldi mine. Initially, in this Rudnik, to increase the depth of the shpurs from 1.6 to 1.8 m, shpur was used, designed to form a cylindrical groove with a diameter of 42 mm. Next, to simplify the scheme, a cylindrical cross-section with one shpur is drilled in the center with a diameter of 70 mm. Compared with conventional diameter shpur drilling, the drilling time of shpur with a diameter of 70 mm has increased 2 times. At the same time, the distance between the Spurs in the groove increased to 260-300 mm (mostly 185 mm), the number of Spurs decreased from 8 to 6 without worsening the explosion indicators. In this case, taking into account the duration of auxiliary operations, the increase in the drilling time of the Central shpur was completely compensated by a reduction in the drilling time due to a decrease in the number of Spurs [15]. The advantage of using this method is determined by the overall cost-effectiveness of drilling deep shpurs, saving time and funds (due to the relative reduction in loading, blasting, ventilation times, increasing labor productivity when loading daggers, etc.). Shpur bundles with an enlarged diameter are usually drilled between the cylindrical groove. The literature presents many examples of the use of large diameter shpurs in the groove. Currently, the use of larger diameter shpurs as a means of increasing depth is not so common, but at the same time, practical data show that under certain conditions, one of the ways to increase the depth of shpurs by increasing their diameter is possible. From the foregoing, it follows that the use of the correct prismatic groove structure ensures the high efficiency of the passage using the method of blasting the underground horizontal mine sarcophagi, since it provides high-quality formation of the groove plane and optimal values u200b. In the kowuldi mine, the following two different types of grooves for different conditions were considered: a steep-wedge groove and a pyramidal groove with a compensation shpur. At the time of drilling the Spurs, a

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perforator of the PP-63V was used. The Spurs were drilled with a diameter of 42 mm of the KTP model, and the compression Spurs were drilled using a 70 mm diameter torsion head of the bkr-K model. Lahim transverse cross-section surface 12.0 m^2. The placement of explosive cartridges (Almanites)in the shpur is carried out manually. The specific consumption of the explosive is 2.4 kg/m^3. The excitation of explosive charges was carried out using a kpm blasting machine using a non-electric Iskra-sh blasting system. After the explosion, according to research carried out, the average value of the "Spurs ' residue" was 15.0 sm. The coefficient of use of shpurs is equal to 0.90, its results are shown in Figure 5 [16].

Figure 5. Depth of "shpur residue"in horizontal mine

At the same time, by sequentially increasing the depth of Spurs, it is possible to characterize the invariance of the coefficient of use of shpur as follows:
- the use of ordinary or wedge-shaped grooves by increasing the number of Spurs – - the use of two, three and a large number of pyramidal grooves is especially effective when the transverse cross-sectional surface of the Lahim is more than 10 m^2 and is effective on rocky slopes;
- the use of cylindrical grooves is considered to be the most effective way to increase the depth of Spurs by drilling additional discharge Spurs;
- increasing the diameter of the Spurs in the kit, as well as creating an additional concentration of explosives on a small-scale surface.

Schemes of placement of Spurs with a not large depth in the cowgoy. Spurs are placed in the order established by the Kon lahimi kovjoy, divided into carving, auxiliary (grinder) and delimiting types. It is the convergence of the distance between the Spurs and the increase in the number of Spurs that makes it possible to improve the degree of crushing of the daggers as a result of the explosion. Before blowing up the shpurs, the Kon lahimi Cowboy will have only one open surface. In order to improve the efficiency of blasting operations, Spurs are first detonated, which are intended to make additional open surface dressing. At the base of the mine in Lahim, when the taggjins are in mixed form (when the ore and the surrounding taggjins are in contact together), the groove is used to organize the extraction work in Alochi (by

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blasting or mechanical method). Blast grooves are created by detonation of limited Spurs, and these

- oblique;
- right;
- combined (mixed).

Auxiliary (grinder) Spurs are used to expand the groove, which are characteristic as a result of the explosion. At the transverse cross-section border of the mine sarcophagus, the main crushing of the mine mass is carried out using Spurs. The delimitation of the mine sarcophagus by an array is carried out with delimiter (contouring) Spurs, in which these Spurs are drilled at a slope of 85-870 relative to the surface of the Cowboy, through which an increase in the clay content value to 10-12 cm is ensured [17].

Among the carved Spurs, the most commonly used Spurs are those that are drilled obliquely in relation to the kovjoy or use vertical wedge, central pyramidal, bottom, top, side-oriented grooves. Vertical wedge grooves are convenient and common for drilling in practice. Steep wedge-shaped grooves will be possible to apply Ham in relatively medium-strength, robust and extremely robust ridges. In the complex of wedge piles, the number of relatively Spurs is small, respectively, the consumption of explosives is also reduced when their depth is small. When applying wedge piles, the mine sarcophagus is divided into three parts by vertical lines, the shpur in the Maraz serves as an axis. The pyramidal, lower, upper and side incisions are similar in shape to a steep wedge groove. The pyramidal groove is usually used in strong monolithic and viscous thickets. The main condition for the effectiveness of the use of a pyramidal groove is described in the accuracy of drilling the shpur by the calculation of ensuring the convergence of the cut shpurs at the top of the pyramid. The lower, upper and side grooves are used on ridges with strong layers. Carved Spurs in this case are drilled perpendicular to the layer. The greater the inclination of the carving shpurs to the surface plane, the more effective the results of the explosion. [18-59].

All grooves of this type are reasonable when drilling small depth shpurs, and the small surface transverse section will be limited by the slope of the surface mine sarcophagus and oblique shpurs to the face plane. The strength of the ridges and the transverse cross-section surface of the mine sarcophagus, the change of a simple wedge groove is shown in Table 3.

Table 3

Depth and angle of inclination of the wedge groove depending on the strength of the edges and the transverse cross-section surface of the sarcophagus

the strength coefficient of the edges, f	is the depth of the shpurs on the small transverse surface, м			is the angle of the groove slope, gradus
	2	3	4	
2-4	1,85	2,8	-	30
4-6	1.4	2,0	2,75	40
6-9	1,2	1,8	2,4	45
9-12	1,1	1,6	2,0	50
≥12	0,9	1,3	1,7	60

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Carved Spurs are drilled 10-20 cm long compared to auxiliary and crushing Spurs. When simultaneously blasting carved shpurs, their drilling will be possible from the center of the mine sarcophagus. In the case of a separate explosion of relatively hard ridges, the Spurs are drilled between them, leaving 10-20 cm from each other in relation to the center. At the kowuldi mine, we experimentally determined the central angle of the wedge groove and the number of Spurs in it, in which the least specific consumption of explosives for a particular workpiece is achieved.

Conclusion

Wedge grooves with increased Spurs depth. With an increase in the depth of the Spurs, the character of the groove may not change, but due to the specific consumption of explosive material for the number of Spurs, the coefficient of use of Spurs decreases compared to the first. To maintain the value of the coefficient of use of Spurs, it is required to increase the specific consumption of explosives and the number of Spurs. Thus, an increase in the depth of the shpurs in comparison with the shpurs of ordinary wedge grooves leads to an increase in the specific consumption of the explosive substance if the coefficient of use of the shpurs is unchanged. Therefore, when the surface of the mine sarcophagus and other conditions are unchanged, the detected depth of the wedge groove is really ensured by the minimum specific specific specific specific consumption of explosives. In the conducted experimental tests, the number of Spurs and the value of Almanite charges were left unchanged. Only their mutual location was changed. The awakening of the explosion in explosive charges was carried out with an EDZN detonator with a deceleration of 5 Series (2 units in Series 1, 4 units in Series 2, 2 units in Series 3, 6 units in Series 4, 16 units in Series 5). In the space carved in all groove structures, the value is 0.90-0.93, and in kovjoy-on average 0.89-0.90, and in comparison with deposits with similar mining and geological conditions, it is minimal.

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