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INVESTIGATION OF THE LOCKING ACTION OF THE DEVELOPED DRILL AS A FACTOR IN IMPROVING THE EFFICIENCY AND SAFETY OF BLASTING OPERATIONS WHEN BLASTING HOLE CHARGES OF EXPLOSIVES

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Annotation. A review of literature sources is given, reflecting the effectiveness and necessity of the use of boreholes and boreholes, the mechanism of interaction of the borehole with the surrounding rock mass during the detonation of the borehole charge of explosives, and also the developed design of the locking borehole made of certain materials, such as polypropylene, polymers, etc. The technical result is the possibility of increasing the efficiency of the penetration of underground mining and the improvement of the coefficient the use of boreholes and boreholes.
Keywords: *drilling of boreholes, explosives, explosion energy, mountain massif, Utilization factor of the Borehole, mining workings, wedge, retainer, explosion products, the efficiency of the slaughter, Tamping.*

ИССЛЕДОВАНИЕ ЗАПИРАЮЩЕГО ДЕЙСТВИЯ РАЗРАБОТАННОЙ ЗАБОЙКИ КАК ФАКТОР ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ И БЕЗОПАСНОСТИ ВЕДЕНИЯ ВЗРЫВНЫХ РАБОТ ПРИ ВЗРЫВАНИИ ШПУРОВЫХ ЗАРЯДОВ ВВ

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Аннотация. Приведён обзор литературных источников, отражающий эффективность и необходимость применения забойки шпуров и скважин, механизм взаимодействия забойки с окружающим горным массивом при взрывании шпурового заряда взрывчатых веществ, а также приведена разработанная конструкция запирающей забойки из определённых материалов, таких как полипропилен, полимеры и т.д. Техническим результатом является возможность повышения эффективновсти проходки подземных горных вывработок и увелечиние койффициента использовани шпура (КИШ) и скважин.

Ключевые слова: *бурение скважин, взрывчатые вещества, энергия взрыва, горный массив, коэффициент использования скважины, горные выработки, клин, фиксатор, продукты взрыва, эффективность забоя, забойка.*

PORTLOVCHI MODDALARNING SHPUR ZARYADLARINI PORTLATISH PAYTIDA PORTLASH ISHLARINING SAMARADORLIGI VA XAVFSIZLIGINI OSHIRISH OMILI SIFATIDA ISHLAB CHIQILGAN TIQINLAR TA'SIRINI O'RGANISH

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Annotatsiya. Shpurlar va quduqlarni portlashning samaradorligi va zarurligini, portlovchi moddalarning portlash shpur zaryadini portlatish paytida haydashning atrofdagi tosh massasi bilan o'zaro ta'siri mexanizmini aks ettiruvchi manbalarga sharh berilgan. polipropilen, polimerlar va boshqalar kabi ma'lum materiallardan tayyorlangan qulflash dastani beriladi. Texnik natija - yer osti konlarini haydash samaradorligini oshirish va skvajina (KISH) va quduqlardan foydalanish koeffitsientini oshirish imkoniyati o’rganiladi.
Kalit so’zlar: *quduqni burg'ulash, portlovchi moddalar, portlash energiyasi, tosh massasi, quduqdan foydalanish darajasi, kon ishlari, tiqin, tutqich, portlash mahsulotlari, quduq portlashining samaradorligi, tiqinlash.*

The bulk of mining operations at coal and ore mines are currently carried out by drilling and blasting, therefore, the issues of increasing the efficiency of blasting operations are of paramount importance. Special attention should be paid to improving the efficiency of the explosion when conducting blasting operations by the method of borehole charges, which in fact is the only one in the practice of mining operations.

In the «Uniform Safety Rules for blasting operations» [1] it is said that in order to increase the effectiveness of the explosion and increase the safety of blasting operations, high-quality hammering of borehole charges is necessary. In previous studies [2], when studying the mechanism of destruction of rock mass in the zone of a hole filled with a downhole. Taking into account the modern level of structural materials, it allows rationally distributing the energy of the explosion along the entire length of the hole and opens up new directions for improving the type of slaughtering.

One of the factors determining the conditions and the effectiveness of the explosion of explosive hole charges is the internal plugging of the holes. Its size and quality largely determine the utilization rate of boreholes, the uniformity of crushing of the array, as well as the amount of dust and toxic gases entering the mine atmosphere during an explosion.

All studies of explosive issues, both analytical and experimental, should be based on the physics of the destruction of a rock mass by the energy of an explosion. Without a deep understanding and consideration of the features of the processes occurring in the environment destroyed by Explosives, it is impossible to properly design the work and, consequently, to obtain the proper effect from their implementation. Therefore, the role of slaughtering in the process of explosive destruction of rocks should be considered in close relationship with the mechanism of explosion itself and, first of all, with the impact on the destroyed array of static pressure of detonation products and shock waves.

Modern ideas about the distribution of explosion energy are diverse and contradictory. Some researchers believe that the main factor determining the effectiveness of the explosion is the piston pressure of the detonation products (the expansion of the detonation products can be represented as the action of a spherical, expanding piston), others believe that the destruction of the array during the explosion occurs mainly due to the action of direct and reflected shock waves.

G.P. Demidyuk in his work [3] notes that in the presence of a plug, the explosion products can quickly escape into the atmosphere and, pushing apart the material of the walls of the charging cavity, compressing it, they themselves are repeatedly reflected from these walls, as a result, the pressure spreads in all directions. This is how the process of destruction of the environment surrounding the charge begins; the duration of this process is many times longer than the time of detonation of the charge.

I.V. Karasik cites that in order to achieve high efficiency of slaughtering, the material of the latter must have the highest possible adhesive strength. Ideally, from this point of view, there would be an internal face, the material of which has an adhesive strength equal to the strength of the rock in an undisturbed massif. At the same time, he argues that the inertia of the rest of the face mass cannot have an almost tangible effect on the quality of the explosion, since «the so-called inertia of the rest of the face mass is the resistance to its dynamic load, only twice as much as the resistance of the face to static load» [4].

It is noted in [5] that it is wrong to take into account only the mass of the face and not take into account the friction forces and internal adhesion of the material at all. It is known that excessive moistening of the sand-clay face leads to a sharp deterioration of the explosion, although the mass of the face does not decrease.

V.E. Alexandrov, N.R. Shevtsov, B.I. Vanstein in [6], the mechanism of interaction of the face with detonation products is presented as follows: «from the moment the detonation of the explosive charge begins, gaseous detonation products, acting on the face of the face, tend to move it. Resistance to the ejecting action of detonation products is provided by: inertia of rest, the mass of the face, the forces of internal friction and adhesion of the particles of the face material. But immediately after compaction of the latter, the face is shifted and its movement is prevented only by the mass and internal friction forces. The influence of the forces of internal adhesion between the particles of the face material in the general resistance exerted by the face by detonation products, compared with the friction forces and inertia of the rest of the face mass, is negligible. The share of friction forces accounts for more than 90% of the total resistance exerted by the detonation products.»

Of considerable interest are experimental studies of the process of explosive destruction of rocks performed by I. Kotov [7]. With the help of high-speed filming, he found that during an explosion, the time of the beginning of separation and displacement of rocks after the initiation of charges is 30-40 times longer than the time of passage of a straight line and reflected shock waves. Based on his research, I. Kotov considers the value of the backfill from the point of view of the destruction of the array by the swelling action of the explosion, in which the high pressure of detonation products in the holes and in the natural network of cracks must be maintained for a relatively long period of time.

G.Jonson and V. Hofmeister [8], investigating the impact of the slaughtering on the results of the explosion of charges in boreholes with a diameter of 36 mm, as a criterion for evaluating the effectiveness of the explosion, they adopted the limit line of least resistance, i.e., one at which the explosion of the charge still produces rock breaking. Experimental explosions carried out in pure single-rock rock salt at the Mariagluk mine (Germany) showed that the maximum l.n.s. when using a face is higher than in the case of exploding charges without a face.

Undoubtedly, in borehole and borehole charges, the degree of closure of which is incomparably higher than that of external charges, the backhole will have less effect on the completeness of detonation, but still, especially with direct initiation, it will prevent the loss of energy necessary to maintain the detonation process itself.

The punch increases the effective shock wave length and the initial pressure of the explosion gases. According to the theory of the destruction of rocks by a reflected wave, the line of the highest resistance overcome by the explosion of an explosive charge is proportional to the efficiency of the wavelength. According to Kumao Hino [9], the face should ensure the preservation of high pressure in the charging cavity for a period of time sufficient to complete the separation of the formation in the entire area from the free surface to the charging cavity.

The plug increases the duration of the piston impact of detonation products on the walls of the charging cavity and primary cracks formed at the boundary with the charging cavity during the occurrence and passage of the shock wave of the explosion. According to the studies of A.F. Belyaev and M.A. Sadovsky [10], with the same magnitude of the explosion pulse, the volume of the general forms of explosion work is greater the longer the pulse duration, i.e. the longer the pressure of the explosion gases affects the walls of the charging cavity. The effectiveness of the use of Explosives of the igdanyte type is directly related to the increased width of the chemical reaction zone in such Explosives, which results in a reduced initial pressure, but a slower pressure drop; the role of the hammer for such explosives is especially significant.

A.N. Hanukaev in [11] notes that the backfill provides a longer and more intense effect of gases on the walls of the charging chamber. This in turn leads to the formation of a wave with a much longer length, higher voltages and a reserve of energy. Thus, in the case of the use of a downhole, the voltage at the wave front is greater, this is due to the more intense effect of gases on the walls of the charging chamber due to the resistance exerted by the downhole to the exit of gases from the well.

Long-term studies have established that at the high speeds at which the explosion phenomenon occurs, the downhole provides significant resistance and holds the detonation products of Explosives inside the well for a time sufficient to perform useful work on the destruction of rock, thereby ensuring relative safety. Conducting a large number of experiments made it possible to establish that if the inner face does not delay the detonation products inside the gas chamber for a time exceeding 3 ms., it no longer prevents a decrease in the utilization rate of the Hole and the emission of dust and detonation products.

In general, the time of ejection of the cull can be an unambiguous criterion only for a very specific type of it. Since the downhole prevents the expansion of the explosion gases, increases the time they are in a closed cavity, the residual energy of the detonation products and their temperature when gases break through into the downhole space significantly reduce the utilization rate of the Hole with air.

The absence of a downhole, especially when filling holes and wells with explosives to their entire depth to the mouth, is accompanied by the removal of dusty particles from the crushing zone and pieces of rock from the mouth of the charging cavity. In case of an unsatisfactory explosion of a set of borehole charges, the unused energy of the explosion raises a large amount of dust, while the face reduces the dustiness of underground workings, and the dustiness decreases by increasing the quality of the face. When sand-driven, its resistance increases with a decrease in humidity, as a result, the amount of dust decreases. Pneumatic introduction of an impure salt face at the mine named after Gottwald in Czechoslovakia reduced dust by 52.2%.

Ensuring the completion of secondary reactions with a stopper reduces the amount of toxic gases in the detonation products. According to the Hungarian scientist I. Koty, in a coal face with a cross section of 10m2, as a result of improving the quality of the face by replacing clay with fine crushed stone, other things being equal, the content of nitrogen oxides in the bottom hole space decreased by 8, and carbon monoxide - by 13.8 times.

At the mine named after Gottwald in the Czech Republic, the transition to pneumatic injection into a hole for a length of 30-40 cm of raw rock salt, in addition to increasing the efficiency of the chipping, reduced the content of carbon monoxide by 52.8% and nitrogen oxides by 23.7% [12].

The face under the piston action of gaseous explosion products flies out of the hole in the form of a cloud consisting of crushed small particles and explosion products cooled to a safe temperature.

In order to increase the resistance of the face, the energy of the explosion and the delay time of the face in the hole, we have developed a design of a locking face based on a material, polypropylene or polymers.

The developed face can be used in the sinking of underground mine workings for the destruction of rocks of various strength. When conducting drilling and blasting operations with borehole or borehole charges of explosives, the charging method includes laying an explosive charge and detonating agents into a hole or well, then sending a locking hole with a hammer, a connected wedge-lock assembly and fixing it with a sharp push in the hole (Fig1).

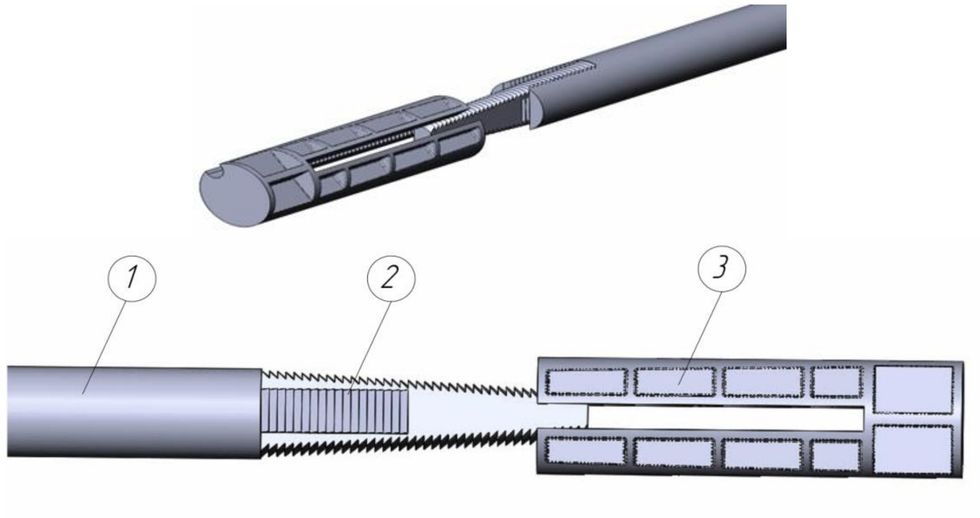

Fig. 1. Fixed schemes of the developed design of the locking face

The location of the wedge-retainer device in the hole is carried out by a retainer to the explosive and a wedge to the mouth of the hole. The wedge-retainer is made of plastic. The wedge-retainer includes a retainer with sliding cylindrical cheeks and a wedge interacting with them, made with a cylindrical base. Grooves are formed on the outer surface of cylindrical cheeks for electrical wires or means of non-electrical initiation (depending on the method of detonation). Ribs are made on the wedge for fixing and disassembling the structure, and toothed protrusions are made on the retainer, through which the wedge is pre-fixed with a retainer.

The edges of the wedge are positioned longitudinally on the transverse shelves of the wedge from the outside and on the tank of the wedge, and the toothed projections of the retainer are performed on the sliding cheeks of the inner part of the retainer. The locking face provides resistance to the energy of the explosion of the general design of the wedge-retainer in the hole.

The technical result is the possibility of increasing the efficiency of underground mining workings and increasing the coefficient of use of the hole and wells (the coefficient of Use of the hole) of the hole.

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The slaughter is realized by using a wedge-retainer product. During its development, the experience of working with various types of stopes, locking devices of the hole and borehole was taken into account. Features advantages of the wedge-retainer product in the application of the product for fixing in the hole of patronized, granular and emulsion explosives in the hole or well. The formation of a spur charge with a locking face is shown in Fig. 2

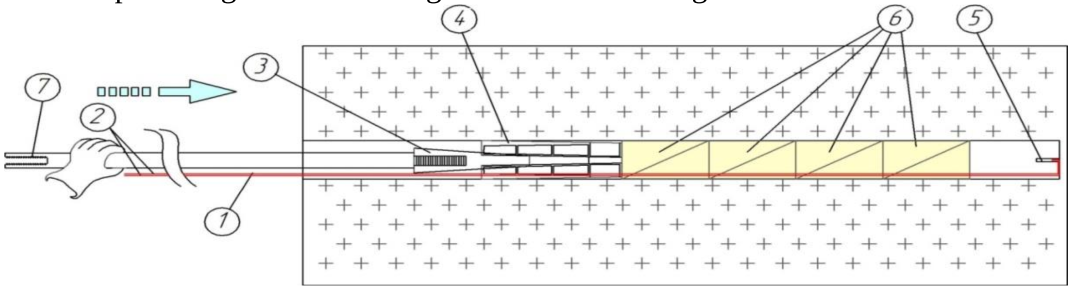

Fig. 2. Formation of a spur charge from a locking face.

In order to ensure the safety and quality of blasting operations, there is a need for dismantling in case of failures or damage to the commutation explosive network in the process of forming the structure of the hole (borehole) explosive charge.

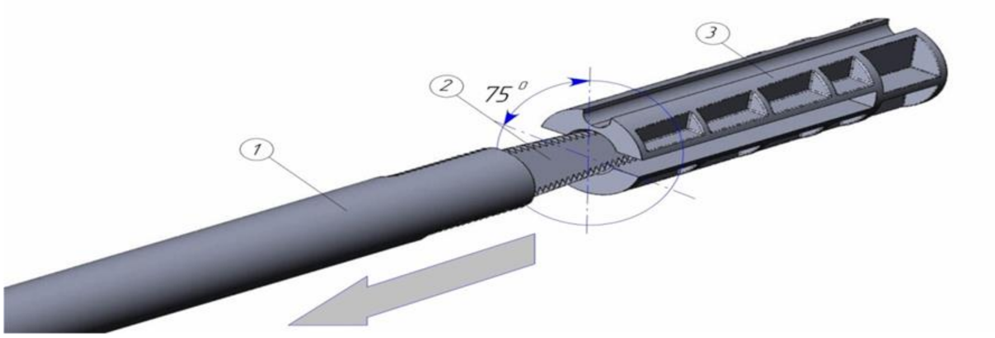

Fig.3. The scheme of removing the face in case of emergency

(Fig. 3.) shows a scheme for dismantling the locking face, for dismantling by a developed special face (1) having a groove (2) with a width corresponding to the width of the wedge (3), the protruding part of the wedge is captured and with the opening of the face with a wedge at 75-900 degrees, the wedge is extracted from the retainer and the developed face from the hole.

The advantages of using a wedge-retainer product:

1. Wide temperature range of application from +40 to -30C°.
2. Complete independence from such factors as humidity, the presence of water.
3. Fast fixation in the hole, 5-10 seconds.
4. Light weight 75 grams (± 2%).
5. Low cost due to the use of polymer materials.

Based on the above studies , the following main conclusions can be drawn below:

1. The role of slaughtering in the process of explosive destruction of rocks should be considered in close relationship with the mechanism of explosion itself and, first of all, with the impact on the destroyed array of static pressure of detonation products and shock waves. At the same time, it is necessary to take into account the nature of the rocks being destroyed.
2. Long-term practice of conducting blasting operations and special studies have shown that the internal hammering of boreholes has a significant impact even on such important characteristics of explosives as efficiency and brisance.
3. The analysis shows that the utilization factor of the hole (the Utilization Factor of the Holes) is one of the main criteria for the quality of the explosion. Under the conditions under consideration, the utilization rate of the Drill hole on average reaches 0.89-0.90.

4. It is recommended that research work be carried out to find new scientifically-based ways to improve drilling and blasting operations during the sinking of underground mine workings in general.

5. One of the ways to improve Drilling and blasting operations is the development of fundamentally new designs of borehole charges for use in underground mine workings, allowing to increase the utilization rate of boreholes (the utilization Rate of Boreholes), the step of moving the face for the explosion and increase the volume of the exploded mass in one cycle.

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