

Improving the effectiveness of explosive breaking on the bade of new methods of borehole charges initiation in quarries

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Abstract

The investigations complex for the explosive breaking effectiveness improvement is presented. The universal channel booster, a differential characteristic of which is the combination of the detonating explosive charge with a longitudinal cavity for the increasing the stable state of detonation is described.
 Key words: EXPLOSIVE, QUARRIES, BOREHOLE CHARGES

In the development of rock massifs principal method of breaking are drilling and blasting operations, which have no alternatives in foreseeable future. The efficiency of the mining enterprise depends on the quality of rock mass crushing, which must meet high requirements. An important aspect of effectiveness increase of breaking in quarries remains prospecting of new explosives. The works on development of effective methods of blasting remain to be actual. High efficiency of benching breaking of rocks in the open field development is achieved by using borehole charges with axial cavities and universal channel booster. The diameter of the axial cavity is 15-20% of the blasting borehole, what allows reducing the con-

sumption of explosive materials by the same amount, without reducing the quality of rock mass crushing. The high quality formation of cavities in the borehole charges is achieved by the use of special garlands of hollow elements that have a ensure completeness and stability of detonation, reduce emissions of explosion products, and allow to reduce the subdrilling value by 30-50 %.

The use of explosives mixtures with conversion additives in quantities of 20-30%, priming by developed powerful universal channel booster enables reducing the cost of blasting operations [1]. The investigations complex is characterized by Fig. 1.

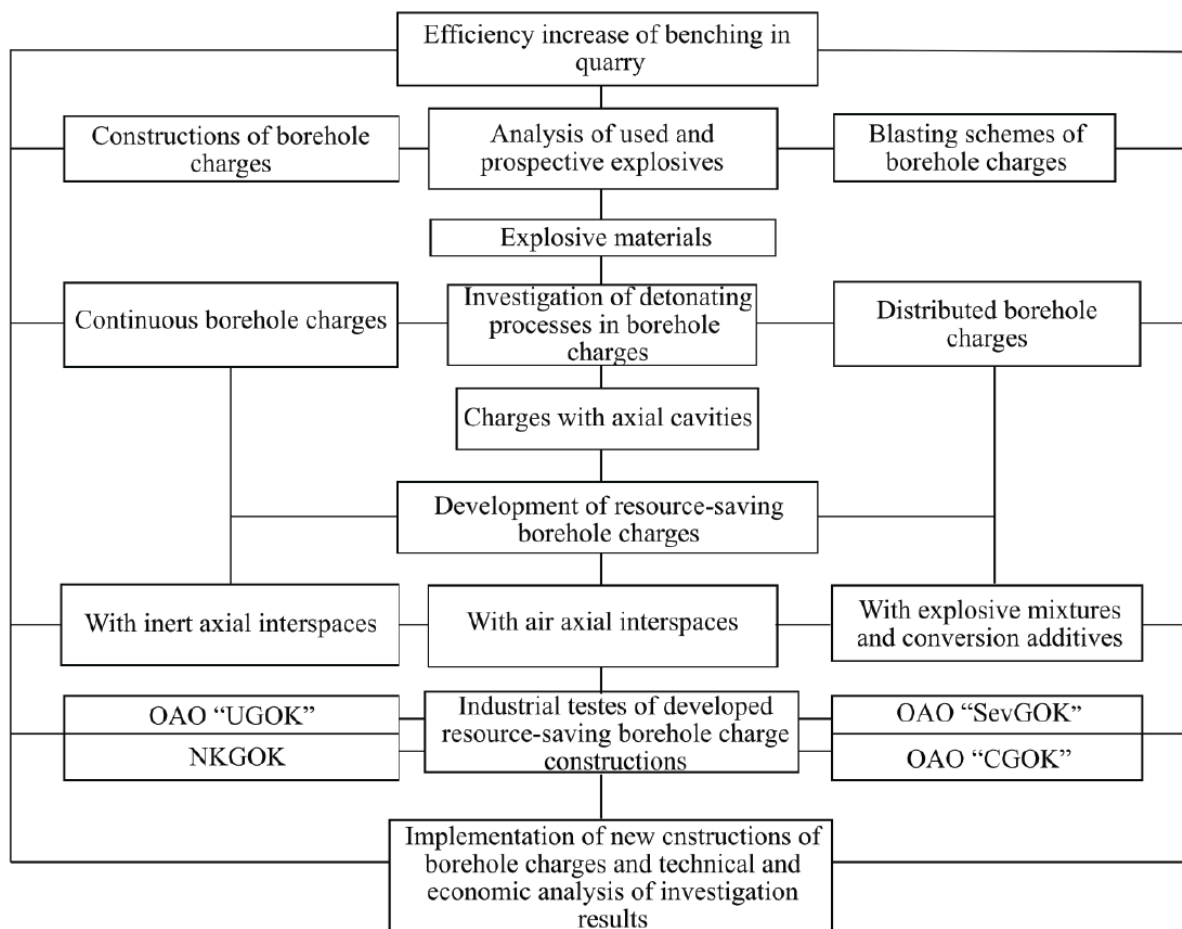


Figure 1. Structural scheme of investigations

Investigations in the field of rigid body destruction are concentrated on solving of fundamental problem - the atomic mechanism of fracture, within the framework of which there considered the origin and spread of crystalline defects caused by the external load, i.e. additional external field [2]. One of the decisive factors determining the parameters of drilling-and-blasting operations in the quarries is the type of explosive used for borehole charging. According to structure, existing charges of explosives are divided into several groups: continuous borehole charges, distributed borehole charges and combined charges [3]. To improve efficiency and environmental safety of blasting operations it is advisable to use the explosives with a low content of TNT, as well as emulsion and gel explosives with detonating charges and also unusable ammunition. For effective structure of charges, it is necessary to direct attention towards borehole

charges with axial cavities, and for blasting schemes are preferable diagonal schemes with non-electrical initiation systems [4, 5].

Granulated, water-filled, and suspension explosives differ by some stolidity, therefore to increase their reliability and efficiency, it is required to use special means of initiation. As special means of initiation can be used boosters, made of detonating the charges in combination with the elongated channel.

The shock wave excited in front of the detonation from the initiating pulse of intermediate active charge initiates the chemical decomposition of explosive surface on the contact with the intermediate detonator and rushes in a channel filled with air. During this process the explosion process is altered and is considered as a heterogeneous system of layered texture of explosives and gas. Such a process can be characterized as a two-layer detonation (Fig. 2).

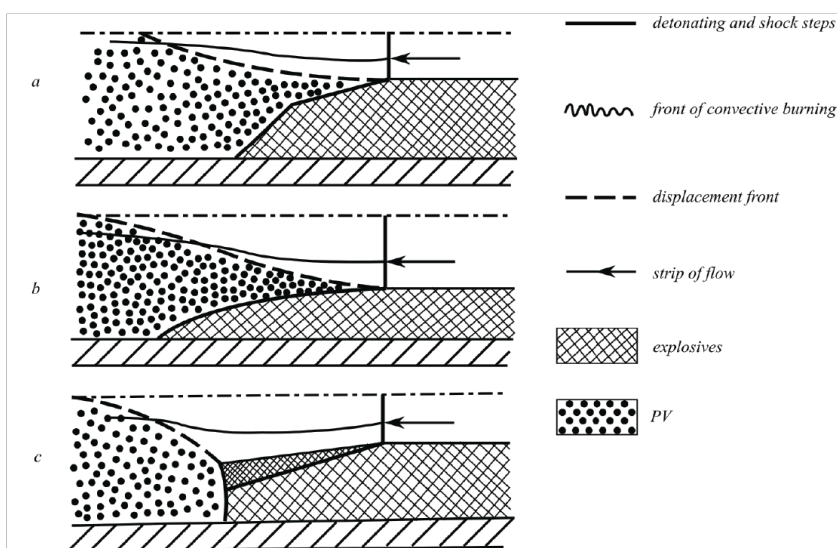


Figure 2. Transfer from low-velocity detonation to a full detonation of main charge

Investigations of effect of borehole charges with axial air channels determined that the channel shock wave can change the parameters of detonation, increasing velocity and causing substantial alterations to the flow of detonation in the zone of chemical transformation of canal wall substances. Therefore, borehole charges with the axial air or inert channels should be considered as a system of layered structure consisting of explosives and gases. Scheme of the detonation flow process - from an intermediate detonator into channel passes detonation wave, which is pushing through the channel "piston" of the gaseous explosion products in the direction of detonation flow. Products of explosion compress a detonation wave behind the detonation front, and due to this kind of booster there created conditions of charge preknock along the length of the air cavity that provides velocity of an explosion flow in elongated borehole charge in 1,2-1,3 times more than the nominal [6].

We have developed a construction of so-called universal channel booster structural feature of which is the combination of detonating explosive charge with a hollow cavity (Fig. 3).

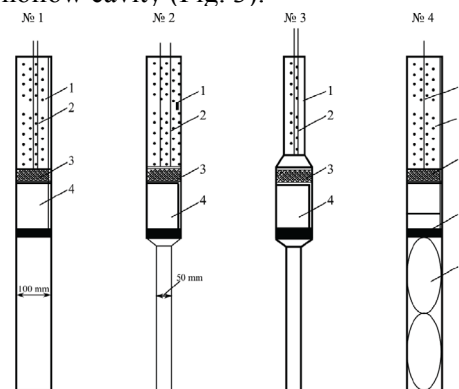


Figure 3. Constructions of intermediate detonators-boosters (UCB): 1 - stemming; 2 - thread of DSE-12; 3 - container; 4 - blasting cartridge T-400G; 5 - waveguide U475; 6 - blasting cartridge DPU-830; 7 - plastic bottles

Typical borehole charge construction with a channel booster is shown in Fig. 4.

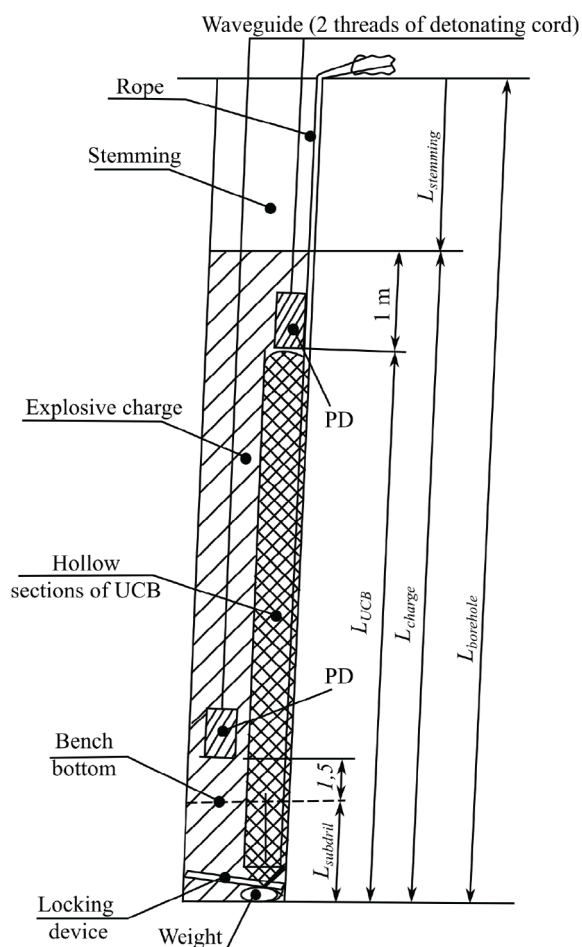


Figure 4. Borehole charge with universal channel booster

Creating interspaces in the explosive or channels with a garland of hollow waste products when loading the boreholes in different mining-engineering conditions, makes it possible not only to improve crushing of broken massif with the least possible consumption of explosives, but also to dispose production waste, which is one of the elements of energy supply [7, 8-13]. Implementation of developed borehole charges with longitudinal channels allows to improve the reliability of blasting, to reduce the consumption of explosives by 15-20 %, compared with continuous charges, and solve the problem of waste utilization.

Conclusion

The results of industrial tests have shown the reasonability and possibility of general-purpose use of borehole charge structures, based on the use of universal channel booster that was developed for the first time.

To improve efficiency and environmental safety of blasting operations it is advisable to use the explosives with a low content of TNT, as well as emulsion

and gel explosives and utilized military products, in combination with powerful initiation charges. It is appropriate to direct attention towards borehole charges with axial cavities. To increase the stable state of detonation is used universal channel booster, a differential characteristic of which is the combination of the detonating explosive charge with a longitudinal cavity.

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