Cooperative Blasting of Explosive Initiating Black Powder

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ABSTRACT: In the experiment, sulfur-free black powder used to replace the traditional black powder, and the preparation of the performance of sulfur-free black powder was tested to ensure that the sulfur-free black powder explosive performance and storage use in the process of security, but also reduce environmental pollution. In order to reduce the production cost, reduce labor intensity and improve the quality of precious stone blocks, Design of a new charging structure applied to directional fracture controlled blasting. Using slotted stress concentration, through cement mortar test block to simulate the synergistic Explosive blasting stone cutting in the blasting effect. Experimental results show that the design of Explosives common charge structure is reasonable and cooperative Explosives blasting method is feasible. Finally, through the process of analysis of the role of the combined effects of blast and explosion of gas theory, apply that collaborative Explosive Energy Explosive blasting can be made more rational use, to reduce the cost of stone mining ,improve the mining cycle, and improve the quality of the role of blocks.

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1 Instructions

With the advances of technology, the stone mining methods are also constantly improving and updating. In the exploitation of precious stones, the methods by machinery have been to some extent the application. But because that its cost is too high, coupled with environmental constraints, so its use has been severely hampered. Due to directional controlled blasting method has a unique advantage, the stone exploitation methods have been used more and more widely. But in the actual production process found, the method using traditional black powder blasting is difficult to control the direction of rupture, and the security of the traditional black powder is also relatively poor. As for the other blasting methods, are not only to increase the cost and exploitation cycle, but also the quality of the blocks hard to be guaranteed. But due to blasting methods having advantages at the stone exploitation, there is still need for deeper study of them.

2 Sulfur-Free Black Powder Experimental Test

2.1 Formulation Design

In this trial, select the composition of black powder without sulfur ratio of A (KNO_3): B (C) = 80:20. The oxygen balance (OB) is calculated according to generate potassium nitrate (K_2O) and nitrogen (N_2) to account for the +0.396 g • g^{-1}, charcoal oxygen balance (OB) value is -2.667g • g^{-1}.

Therefore, the ratio of black powder oxygen balance value (OB) is:

$OB=A\cdot K(KNO_3)+B\cdot K(C)=$（0.396×0.80-2.667×0.20）$g\cdot g^{-1}=-0.2186\ g\cdot g^{-1}$。

2.2 Determination of burning velocity

Black powder burning velocity test kits in the production:

(1) Paper tube with wax paper production, the specification: diameter 15mm; high-3mm;

(2) Electronic balance weighing 4.00g of sulfur-free black powder, and then into the prepared paper roll in;

(3) Prior to making good small stick pressure medicine, making chemicals in the paper roll is about 2.0cm in height can be.

2.3 Underwater explosion test

According to Underwater Explosion Test Principles for testing. The measured waveforms as follows. Detonators are No. 8 blasting cap, instantaneous power, without sulfur black powder was 6.0g, RDX was 0.2g in Figure 2. Charging structure for the sulfur-free black powder wrapped with RDX, and detonators direct contact with RDX.

As can be seen from Figure 1, single ascending detonators more steep peaks, and after the peak pressure has been dropping. In Figure 2, the peak increase in the flat segment than Figure 1, the pressure increased again in the fall phase of increase was not significant. As the reaction of sulfur-free black powder explosive RDX than the detonator initiation reaction is much slower, so some time after shock arrival sensor gunpowder deflagration pressure wave (combustion pressure wave) before reaching the sensor, thus creating a waveform shown in Figure 2 waveform.

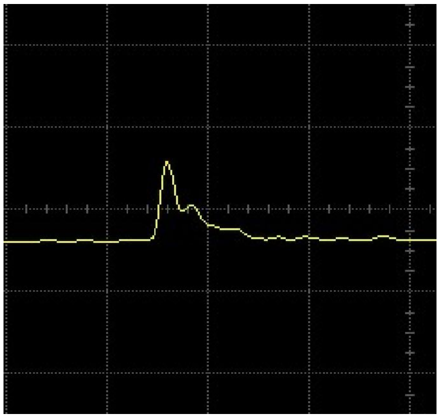

Fig. 1 The oscillogram of underwater blasting by single detonator and the sulfur-free black powder

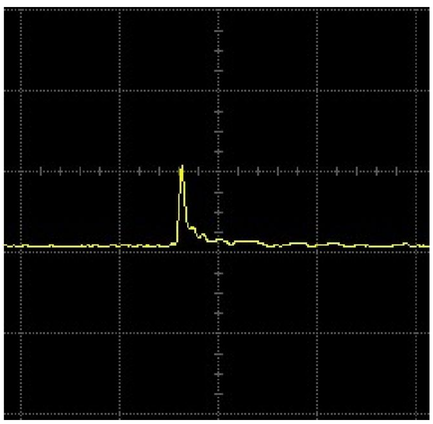

Fig. 2 The oscillogram of underwater by RDX

3 EXPERIMENTAL STUDY OF DIRECTIONAL FRACTURE

3.1 The production of cement mortar specimen

Out the use of cement mortar test block to simulate cut stone. The light of the experience of previous studies, the ratio of concrete test block: cement: sand: Water = 1:2:0.5. Single-hole cement specimen length, width and height respectively 50cm, 50cm, 45cm, 30mm diameter polyethylene plastic tube inserted in the middle, a depth of 30cm, then pull it out until the day after, the formation of holes. Cement mortar in accordance with the conservation requirements of water conservation for more than 30 days. Cement concrete test block model shown in Figure 3.

3.2 Slotted tube parameters

Blasting in the silt-charge, because of the special role kerf, kerf width size will affect the priority of pre-generated crack. In engineering practice, often under the hole diameter, the size of the selection of suitable cutting width, generally 3mm ~ 5mm. In this experiment, select the kerf width of 2mm.

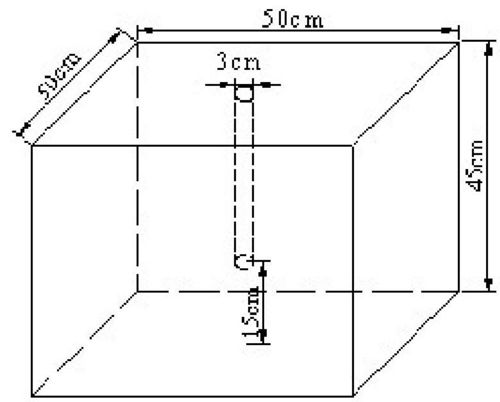

Fig. 3 The schematic diagram of the single-hole cement mortar block

3.3 Slit experiment

Sulfur-free black powder and detonating cord synergies slotted burst mode charge is, the interception of a good length 8cm detonating cord into the 15g sulfur-free black powder cartridge, making the center line of detonating cord and kits the center line of coincidence, the cartridge insert slotted tube, and then insert the instantaneous power detonators, and feet are fix. Shoud detonators and detonating cord at the bottom of contact to ensure the reliability of detonating cord initiation. The charge diagram shown in Figure 4.

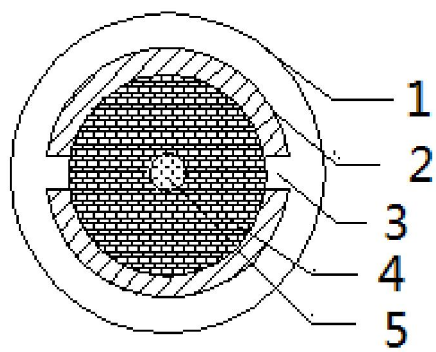

Fig.4 The schematic diagram of the cutting seam charge

1 hole wall, 2 *Slotted tube,* 3 *Slotted,* 4 black powder, 5 detonating cord

Charge structure with the bursting of such effects as shown in Figure 5 and Figure 6. Test block is completely divided into two parts, only in the direction of the test blocks slotted surface of the little bit of damage, not visible in other parts of the crack or damage, and the fracture surface is very smooth, less than the maximum bump 1.0cm,reach to The desired effect.

Fig.5 The figure of blasting effect

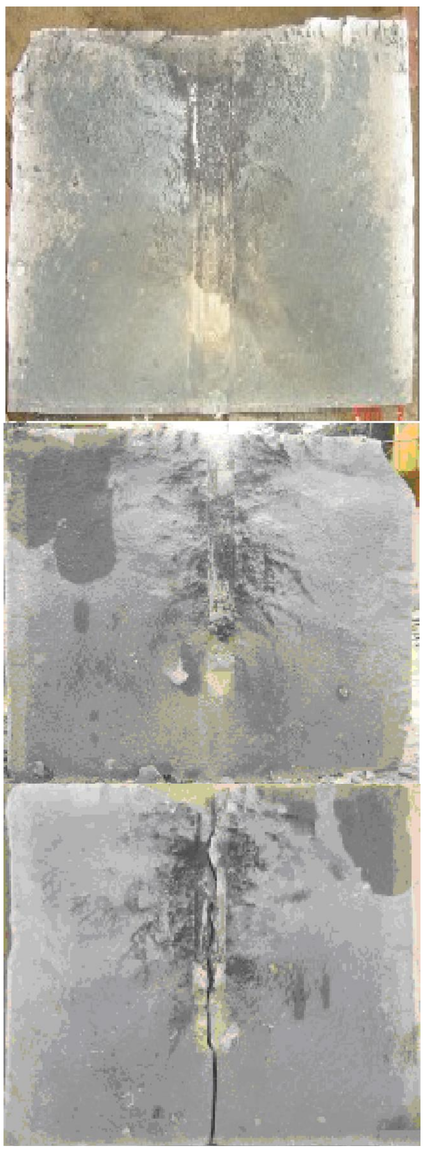

Fig.6 The fracture surface of cutting direction

4 Conclusions

Analysis of the specimen cross section and underwater explosion waveform ,the role of Blasting Explosives collaborative process can be summed up in two stages: the initial explosion, blasting holes yet to form a uniform distribution of pressure before As the slotted tubes slotted guide on the shock wave, making holes in the slotted wall of the direction of the first generation of the initial crack, while powder was ignited; then continued reaction of gunpowder and explosives with detonation gas filled in the hole and the initial crack, it made cracks to expand and link up. As the response of gunpowder taken a long time, can continually replenish the energy required for crack propagation which ensures the pressure to maintain a longer time. Therefore, in this sense, collaborative Explosive blasting can make crack propagation in longer, it is important for practical engineering significance.

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