Study on dynamite charge in rapid excavation by blasting

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Abstract: Blasting technology is the common driving methods, in order to improve the speed of excavation, and the driving quality of roadway, normally in the course of blasting the around eyes should be a low detonation velocity, low density, high sensitivity, high-explosive detonation stable, and low-power explosive. In engineering practice, after the cut holes blasting explosive charges, only the top broken rocks of the department were thrown, while the remaining compression cylindrical charge only have exerted effects, less energy for the rock throwing, so the larger part of the still stuck remained in the groove, the reason is that dynamite charge did not explode generate sufficient amount of gases. About throwing effects, are generally considered by detonation, shock wave and stress wave interaction, in which the most significant effect were expansion effect and the gas of explosion generated. By some experiments, the results showing that explosives and gunpowder joint charges compare with dynamite charge has a significant difference. Firstly, joint charges is a kind of detonator sensitivity of low detonation velocity, low power explosives, the project would be conducted without the help of the air interval charge to achieve the detonating effect, and it will charge directly; Secondly, the joint charges of the detonation gases volume are greater than dynamite charge, markedly enhanced air wedge effect, and the crushing effect has also improved, so to the rapid blasting excavation charge, it will provide a reasonable basis.

Keywords: rapid excavation; cut blasting; joint charge; blasting theory

1. Introduction

When rocking in the mine roadway, the charge choice is a great influence element on the tunneling effect. Although sometimes the cutting mode, blasting parameters and blast-hole layout have a precisely design, but if the explosive charges unreasonable to choose, it will largely affect the construction results, and increased project cost. So, a reasonable choice in the rock charges and charges way are more important. There are some experimental results have proved that there is no displacement of the rock fragments in the bottom of the cut holes (Zhang, 2003), in order to make this part of the rock fragments from the rock, and thrown from the slot cavity, we must provide additional explosive energy. In engineering practice, cut holes often have some deep or empty holes have some deep, and with a small amount of explosives in the bottom of deep air holes, to enhance the effect of cut blasting. This paper introduces a new charging method, and will according to the laboratory simulation experiments, to analysis the final effects.

2. Experimental Model and Blasting Materials

Materials: making the geometric dimension of text block is 500mm × 500mm × 450mm. The ratio of the test block materials are: cement / sand / water =1/2/0.5.The cut hole parameters are: hole depth H=120mm, diameter d= 6mm, hole spacing were 50mm and 100mm, hole angle is θ = 70°(Fig.1). The charge way is uncoupled, using the Hexogen explosive (RDX), and gunpowder (HY) to simulate the joint charge, use the home-made detonators (DDNP) to initiate (Fig.2).

3. Simulation Experiments

3.1. Underwater Explosion Test

To prove the reliability of the layer charges exploded, according to the Underwater Explosion Test Principles (Zhang, 2006) to get the underwater test. The measured

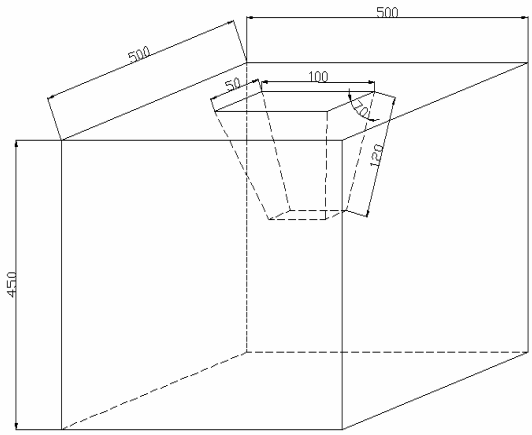

Figure 1 Model size of cement test block

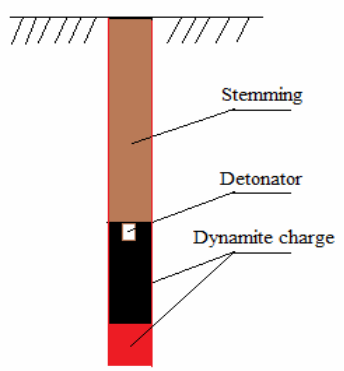

Figure 2 Chart of cut hole charges

cures shown in the Fig.3 and Fig.4, experiments use the NO.8 detonator to initiate. In order to observe the action process better, using the charges structure is powder in the upper, the lower is RDX.

According to Fig.4 can judge the powder and RDX reactions have occurred, and gunpowder deflagration occurred. The combined charges reaction time and the duration of positive pressure is significantly longer than dynamite charge. In addition, it can be seen from Fig.3, dynamite charge relatively steep section of the crest up, and after peak pressure has been dropping quickly, but in Fig.4, peaks ascending to gentle than the Fig.3, and the pressure rise again. It implied that the Joint charges structure have significantly role in promoting the positive pressure time.

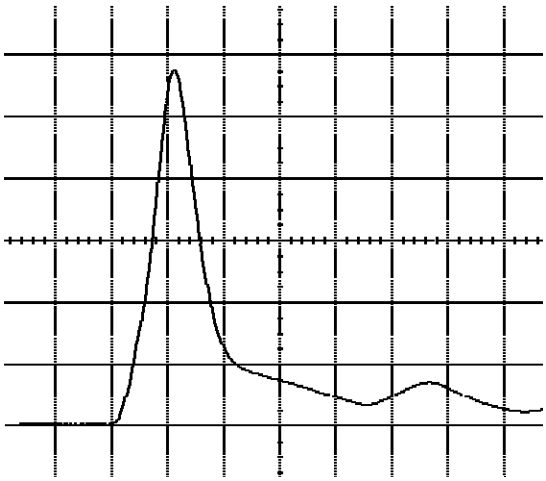

Figure 3 Curve from dynamite charge (*Vertical-axis: Pressure; Horizontal-axis: time*)

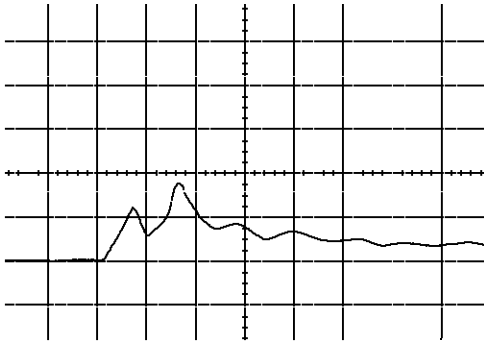

Figure 4 Curve from layer charges (*Vertical-axis: Pressure; Horizontal-axis: time*)

3.2. Specimen Cutting Experiment

To determine the amount of charge in cut hole, according to the formula:

$$Q_p = f(n) q w^3 \quad (1)$$

of which: Q_p- explosive charge in per hole(g);

$f(n)$-blasting index, $f(n)=0.4+0.6\,n^3$ (B.L formula);

w-line of least resistance (m);

q-explosive consumption (kg/m^3) (NO.2 rock commercial explosives).

Uniaxial compressive strength of the test block is 50.63Mpa, according to the standard unit consumption Tunneling take q = 2.74kg/m^3;because the cutting requires a strong thrown results, take n= 1.5, so $f(n)$ = 2.425;According to the diameter and depth of the holes to take minimum resist line w = 30mm, calculated Q_p = 0.1794g, and taking into account the charge density and coefficient of cut holes in charge, determine the explosive charge in per hole is 0.4g (RDX), also on the bottom is the powder in design.

According to Fig.2, following the charging structure to charge in the cut hole, taking into account the actual project, the experimental test block of the outer restraint should also absorb the blast stress waves to eliminate the boundary effect. So, this experiment use the mixture of water and sand, the folder in the production of steel drums clamp the test block under the constraints. Test blocks before and after blasting are shown in Fig.5 and Fig.6.

According to blasting theory, about the analysis of Fig.6 can be following, in the beginning moments explosives, cut holes still form a uniform distribution of pressure. But because of the strong RDX explosive shock wave and the role of the products, making the formation of the cavity expansion generated initial crack, followed by the lower load of gunpowder was ignited, because the response speed of gunpowder can be a long time to add energy, which makes the duration of positive pressure been lengthened to ensure that the blast effect, and be-

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cause powder obvious effect of static pressure of gas generated, so the hole bottom of the throwing effect has been significantly improved.

Figure 5 Before the explosion test block

Figure 6 Test block explosion

4. Conclusions

In the simulation experiments of the test blocks, when the charges are initiated, the RDX almost instantaneously translate into high temperature gases and high pressure explosive products. They directly affect on the media, the media are strong compressed, because of the compressibility of the medium, a cavity formed in the cartridge around and outward expansion. when the cavity expansion process finished, the explosion products in the cavity of the surrounding medium emerged over-expansion phenomenon, which led to the radial movement in the internal test block and the circumferential cracks are formed in the cavity surrounding, followed by the explosion generated the gases will play its role through the cracks and static air wedge effect, so the gravel movement occurred significantly in the bottom of cut holes, and the throwing action occurred under the pressure of the gases. According to the underwater waveform Fig4, we can see, because the two relationships of the length of the shock compression and the explosion products on the role of the positive pressure time to charge wall is proportional, so in the experiments of joint charges way, which lengthening the duration of positive pressure time in the explosion process, so the experiments reach the ideal cutting effect.

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