

Novel special energy for environmental friendly excavation

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Abstract. This paper introduces a new high-energy combustion rock-breaking pillar which can be used for cutting, breaking rock, vibrating vibration, no throwing, no toxic gas generation, no dust, special charge structure is easier to block. Non-metallic raw materials, are easy to produce with low cost, good economic returns, and security.

1. Introduction

In modern construction, blasting is the predominant method used to break rock. The rock breaking efficiency is high, the cost is relatively low, but its resulting vibration, possible flyrock, and toxic gas production makes it a dangerous method from a safety standpoint. Since the 1970's, Western developed countries began to study alternative methods to break rock. During the 1980's, China also started this re-search, although much progress has been made, due to its late start, the overall technology is relatively be-hind. By using non-explosive means to break rock, there are several advantages such as little vibration, no fly stone, no toxic gas, and a high degree of safety. These methods are widely used in municipal engineering, road excavation, high-risk mining, mountain quarrying, and complex environmental rock breaking projects. Some of these methods include mechanical forces, physical chemistry, and electrical stimulus to break the stone.

2. Preparation

The breaker uses a common oxidizing agent, a non-metallic powder as a reducing agent, and a certain amount of binder is added. As the ordinary non-metallic powder particles are large, not easy to break the ingredients of the complete mixing, so the need for high-speed grinding machine grinding, particle size at least 40 mesh sieve. Preparation of pharmaceutical preparation using wet granulation method, this method is uniform particle size, complete mixing. Second, until the oxidant completely dissolved, adding non-metallic powder mixing evenly, continue to heat; third, to be completely broken out of the broken agent, was wet-like, the first to take the oxidant dis-solved in water on the heating plate; Add the binder for granulation; Fourth, the granulation after the wind drying, into the dryer in the spare.

The traditional high-energy crushing agent to use metal oxide and metal combustion, or the use of strong oxidants and metal powder reaction, which may produce harmful gases, such as: NO, NO₂, SO₂, CO₂ and so on. In this paper, high-energy combustion and crushing agent is composed of combustion agent, electrolyte solution and expansive agent. The three parts are relatively independent, and are respectively installed in the combustion chamber, electrolyte solution chamber and expansion chamber. Three pharmacies can be used in the upper and lower parts of the combination of charge structure, can also be used in the structure of the tube and other suitable special circumstances of the structure, the basic principle is to allow the three parts can interact completely. As the three parts are the



combination of charge, it will involve the proportion of the composition of the choice of the problem, according to the theoretical calculation and practical test to determine the mass ratio of the combustion agent accounted for 30% to 50%, expansion agent Mass ratio of 35% to 50%, electrolyte solution accounted for 15% to 20% of the mass ratio. This three-part charge structure can effectively reduce the generation of harmful gases, in the rock-breaking mechanism is no longer dependent on a single high temperature, high pressure gas role.

3. Mechanism of action

This article is composed of combustion agent, electrolyte solution and bulking agent. The rapid combustion of the combustion agent produces a lot of heat, the electrolyte solution is rapidly vaporized under the action of heat, and the swelling agent reacts with the electrolyte solution at this time to produce a substance with an expansion effect while absorbing harmful gases.

The rapid combustion of the combustion agent will produce high temperature, high pressure gas, these gases will quickly act on the surrounding rock, the rock under the action of heat will soften the intensity becomes low, when the internal high pressure is greater than the rock tensile strength, the rock will be destroyed Resulting in cracks, high pressure gas wedge action to increase the degree of rock damage until the crack or broken. It is worth noting that the expansion agent at this time will produce high pressure, the destruction of the rock play a certain role.

In the choice of hole depth, hole spacing, hole spacing to take full account of the blasting rock tensile strength, compressive strength, whether there are cracks, joints, shape size and other factors, but also consider cutting the rock, or Rock broken. Under normal circumstances, do not consider other factors, cutting the rock than the amount of broken rock pharmaceutical dosage much smaller. Generally recommended hole spacing selection of 200 mm ~ 500 mm, row spacing selection for the 300 mm ~ 500 mm, hole depth selection of 600 mm ~ 1 000 mm, the above is only recommended parameters, according to the length of the blasting rock, thickness, strength and other specific requirements Appropriate changes.

When the hole depth, hole spacing, hole spacing to determine the circumstances, but also need to deter potently, it will strengthen the block, to prevent the occurrence of "red gun" phenomenon. And the traditional combustion agent on the plug will be special to strengthen the measures, the test burned rock pill is not needed, the general can be blocked.

High-energy combustion rock-breaking pillars use hot-gas effects, rapid pressurization (where fast pressurization is more like a "fast static bulking agent"), this composite action without air shock waves, no toxic gases, No fly stone throwing, sound small, blasting vibration slightly, easy to ignite the production of high security. And a wide range of materials, low prices, production, transportation, use of security, do not pollute the environment. Applicable to municipal blasting works and precious stone cutting and other special requirements under the blasting project.

4. Experimental

The experimental use of high-energy combustion crushing column does not have detonator sensitivity, detonating cable, detonator cannot ignite, and the use of ordinary detonator head is not easy to ignite. To this end, a special about 10cm ignition electrode, the electrode need to use high voltage to ignite, effectively prevent static electricity.

The electrode with a special internal structure, un-like the use of resistance wire plugs hair heat ignition, the main use of the instantaneous use of high-voltage spark sparking pharmaceuticals. Wherein the ignition electrode is placed in the combustion chamber and needs to be detonated only by turning on the ignition electrode. The general detonator for the initiation of the pillar of the reliability may be lower, so the need to use the market high-power detonator, if a strong electric detonation can also be.

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The single hole charge is not only closely related to the parameters of the hole network, but also by the broken rock shape, strength and other parameters of the impact. The choice of specific dosage can be given in Table 1.

It can be seen from the above table that the dosage used is much larger than that of the general high-energy burner, but this is only the quality of the whole rock-breaking pillar, and the combustant only accounts for a part of its mass. The cost of the whole pill is relatively low. According to the test, in the use of the container will be more than the upper and lower charge to save about 20% of the amount of pharmaceutical dosage. When the need for a large number of the use of broken rock pill, it is recommended to use the tube charge structure, because this structure is more cost savings, but the production process is relatively complex, according to the actual needs of the most consider the use of the most economical charge structure.

Table 1. High energy crusher dosage

crusher	Hole spacing (mm)	Hole pitch (mm)	hole depth (mm)	Cutting single hole dose (g)	Broken single hole dose (g)
Ordinary rock				150~300	200~500
Granite	200~500	300~500	600~1000	200~400	250~650
Reinforced concrete				220~400	260~650
Marble				300~600	450~900

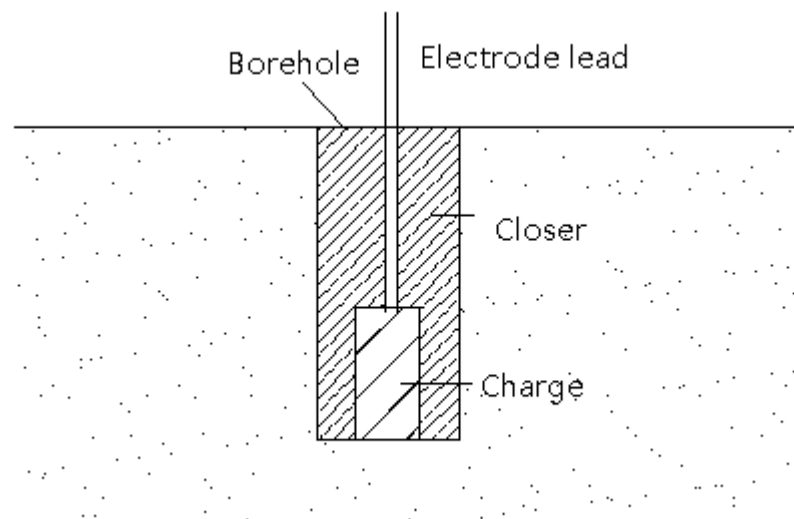


Figure 1. Composition of grain loading

The depth of the hole is related to the thickness of the object being broken, regardless of whether the broken object has a special structure (with obvious fissures, joints, abnormal squeezing, etc.),

$$\frac{H}{2} \leq L \leq \frac{2}{3} H$$

Where: H - the thickness of the object was broken; L - hole depth.

When the broken object is too thin, the hole depth should be reduced accordingly, and the plug should be reinforced accordingly. When the broken object is too thick, you can put a number of drug pillars common detonation, between the pillars can be separated with the stuffing. Blocking with ordinary blocking material can be, if the need to strengthen the closure, available fast hard cement, anchor, etc. to strengthen the block.

The specific cutting test, the crushing test selected in a quarry, the rock nature belongs to ordinary rock.



Figure 2. The rock is cut into two pieces



Figure 3. Rock fragments after blasting

(1) Cutting test

Select a size of $1000 \times 1000 \times 1200$ mm stone, 1000×1000 mm surface in the middle of the hole, hole depth 800 mm, aperture 42 mm, according to Figure 1 structure charge, the drug charge 200 g, with cement, gravel Sealing, the mouth covered with rubber skin, and so on 30 min after the cement completely blocked the hole, with the detonator lit the pill, with a muffled stone rupture for the two.

(2) Crushing test

Select a size of $1000 \times 1000 \times 800$ mm stone, punching in the middle of 1000×800 mm surface, hole depth 600 mm, pore size 42 mm, according to the structure of Figure 1 charge, the drug charge 500 g, with cement, gravel Sealing, the mouth covered with rubber skin, and so on 30 min after the cement completely blocked the hole, with the detonator lit the pill, with a muffled stones completely broken, the farthest stone throwing distance of less than 3 m, stone size Suitable for.

5. Conclusion

It was concluded as follows.

- (1) Test shows that this high-energy combustion broken rock pillar completely with cutting stone, broken stone capacity.
- (2) The high-energy combustion crushing agent from an oxidant, a common non-metallic reducing agent and binder composition, good particle quality, sound small, no throwing, high safety, no toxic gases.
- (3) The high-energy combustion of broken rock pillar by the combustion agent, electrolyte solution, expansion agent composed of three parts, a special charge structure is more conducive to plugging, cost savings, preparation of a wide range of materials, low prices for municipal engineering, Precious stone mining and special conditions of blasting.
- (4) The high-energy combustion rock-breaking pillars are currently only applicable to small-scale rock-breaking engineering. Because of the consistency and synergy of blasting network, it needs to be solved.

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