RIOGUR, A SUCCESSFUL PRODUCT OF MAXAM OF ROMANIA AS SOLUTION TO IMPROVE EFFICIENCY CONTOURING BLAST IN QUARRYING AND UNDERGROUND

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INTRODUCTION

The improvement of surface mining exploitation and / or in underground in Romania requires the application of modern technologies and techniques for getting the best blasting performance, both in conditions of technological efficiency and safety of staff as part of these operations.

When performing the blasting some of the energy released by detonation of explosives is consumed effectively for crushing and detachment from rock massive.

Important part of the energy is lost, for throwing pieces of broken rock into the atmosphere, in the form of kinetic energy (air shock wave), thermal and sound or, in rock massive, transforming on far the spreading from the epicentre of the explosion, in elastic waves (seismic waves).

Therefore, in designing and coordinating the blasting work should consider the following aspects:

• detachment from the massive a needed amount of rock, a corresponding grain to technological requirements;

• slope integrity if those as shaping careers, correct contouring of gallery or exploitation rooms for underground mining.

• protection of civil and industrial targets in the area, the effects of blasting works - air shock wave, seismic effect etc. respectively reducing the discomfort for the human factor.

On surface mining, finding the most favourable methodology has always aimed slope integrity because they will be returned to nature after reconstruction operations, at the end of blasting.

In underground mining technologies to prevent the emergence of blasting over-profiling for tunnels or galleries that achieving a good outline of the room as that does not affect the structure of the pillars for salt mines

Involving the experts from MAXAM Romania, mainly aimed at obtain a new explosive product to meet the technical criteria, also economic and security criteria when using this product, in surface work and underground blasting. This product is called Riogur FCD and used either to achieve final contours for tunnels and other underground works (galleries, chambers of salt-mining etc.), or to have correct profiling slopes for surface mining.

Figure 1. Riogur FCD. Section

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RIOGUR FCD. GENERAL PRESENTATION, TECHNICAL PARAMETERS, USE

General presentation

Riogur FCD is a water gel type explosive having as main oxidant ammonium nitrate and as the main fuel nitrate mono-methylamine and is the

latest development in technology of micro-gels. In the cartridged explosive mass is enclosed a detonating cord with an explosive load of 6 g/m, designed to ensure explosive continuity, flexibility, and improved transmission of ballistic performances (figure 1).

Technical parameters

The main technical characteristics of this explosive are:

- Detonation velocity 3300 - 3800 m / s
- Density 1.15 to 1.18 g/cm3
- Transmission of detonation: 6-9 cm
- Work capacity (mortar ballistic): 65 - 72%
- Gas volume: 932 l/kg
- Toxic gas content: 2,27 - 4, 67 l/100g

The explosive Riogur FCD was tested and certified in specialized laboratories INSEMEX Petroşani.

Riogur currently are manufactured in these sizes and cartridge lengths:
Φ17mm x 500mm, Φ22mm x 500mm, Φ26mm x 500mm, Φ32mm x 500mm, Φ45mm x 500mm.
In special situations, can be manufactured and sizes Φ29mm, Φ38mm and Φ40mm.

Packing

Products are packed in special cardboard boxes, 25kg or 60kg. The boxes are send to customers as pallets (figure 2).

The explosive transport class is 1.1D, which is produced at Victoria, Brasov county, at Maxam Romania working point.

Figure 2. Riogur FCD. Packing

Use and advantages

This type of explosive is used successfully in the blasting of pre-splitting and contouring both opening and sloping at surface works in quarries and underground works and tunnels.

Main advantages:

Comparing the product, in terms of price, with other known on explosives market, certainly is the most competitive.

You can use easily and has a high level of security as well as during transport.

Practically the risk of non-initiation is reduced to zero due to detonating cord in its composition.

Having a detonation velocity of over 3500m/ s, a remarkable thermal stability and very good resistance to water the explosive Riogur FCD is worthy take in consideration by any potential user.

APPLICATIONS OF THE ROMANIAN EXPLOSIVE RIOGUR FCD

Blasting theory of accounts

A blasting hole loaded with explosives creates during the explosives detonation near the load, an area where dynamic resistance to compression is largely over-passed and the rock is crushed and pulverized. Outside this zone of transition, traction strengths generate a compression wave associated with disposal of radial cracks around the entire hole.

In the case of two holes loaded with explosives that detonate simultaneously, the radial cracks tend to propagate equally in all directions until through the collision of two shock waves in the midpoint of the two holes are produced traction complementary and perpendicular on the axial plane (figure 3). Traction in the aforementioned plan exceed the dynamic tensile strength of the rock, creating a new crack and encouraging in the direction of the designed section, propagation of radial cracks.

Subsequently, crack extension occurs by the action of explosion gases which invades and penetrates them. Preferential propagation in the axial plane with the effect of opening the gas pressure provides a cutting plane in accordance with design.

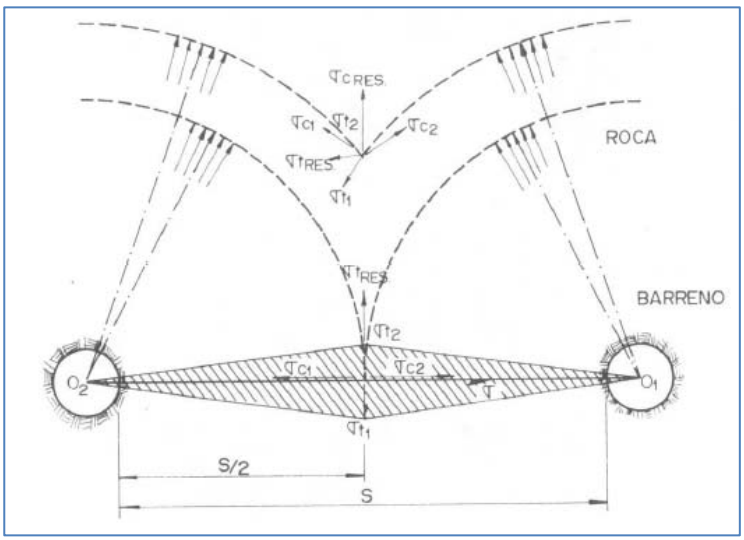

Figure 3. Stage of tensions generated by the superposition of shock waves produced by the simultaneous detonation of two charges

Gas pressure is a key element in the execution of a contouring blasting so it should be maintained until the complete union of cracks starting from adjacent holes, adapting the explosive load length to avoid leakage of gas into the atmosphere.

It can be concluded, that the mechanism of contour blastings comprises two distinct phenomena, one derived from shock wave action and other proceedings gas explosion between the two is maintained a causal link.

Using the explosives RIOGUR FCD in Queries

The first tests of explosive Riogur FCD on surface mining were made in the company LAFARGE AB, with the site Suseni Query. The exploitation was carried out in an andesite rock, stratification structure of rock and its degree of fracturing is highly variable from one area to another. The average density is 2.5 to 2.6 t/m^3 which gives the rock a plastic behaviour, which depreciating the explosive cutting ability.

The presence of clay layers with variable thicknesses influenced a seriously the resulting rock granulation after blasting.

During the operating phases the detonation system was changed by mainly modifying the drilling network and the way of initiation of the blasting network.

In the blasting works the explosive Riogur FCD was used in two types of applications:

• blasting work for achieving final slope of the query

• blasting work to achieve designed production

In the first blasting applications work aimed to obtain final slope of his career, slope located approximately 8 to 10 m from the county road that connects towns Suseni and Odorheiul Secuiesc.

The main parameters of the blasting are the following.

• Height of steps: 14 m
• Anticipate: 2,5 - 3,5 m
• Number of holes: 27
• Number of lines: 1
• Hole diameter: 76 mm
• Distance between holes: 2.2 m
• Contouring explosive:
Riogur FCD diameter 45 mm
• Initiation: detonating cord of 6 g / ml

The charge design inside the hole is shown in figure 4.

After the blasting has obtained a linear slope, with 60 m length without affecting the integrity of the road or nearby soil.

Later in that area was built a parking lot for tourists, a place called "Belvedere".

The second application targeted the use of Riogur FCD explosive in current production work.

It was noted that the basic conditions of use explosives because of their current work blasting the rock crackling behaviour increased after blasting results over- crackling approximately 3-4 m behind the front.

This leads in addition to the emergence of oversized rocks results after the first blasting and the difficulty of drilling holes for the next front line work.

Therefore it was decided to use explosive FCD Riogur diameter of 45 mm on the last row. For it has changed the drilling scheme and how to load and start the boreholes.

Production holes were drilled with 92 mm diameter and the contour 76 mm diameter. Also distances between holes on the same line were different; the distance between production holes was 2.8 -3 m and in the contour of 2.2 m.

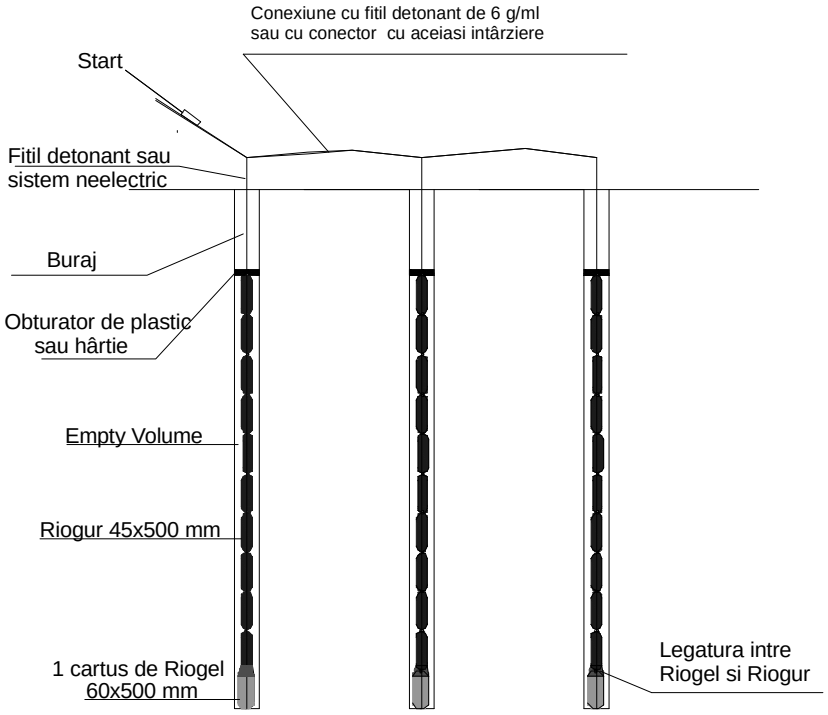

Figure 4. Contour charge design inside the hole

In production holes the explosive column was built with Elexit, Riogur and Nagolită and in contour holes was introduced Riogur FCD at 45 mm diameter and one cartridge Riogel 60 mm diameter on the basis (see figure 4).

Initiation of explosive charges in holes was achieved with non eclectic systems type Detinel.

Scheme shown in Figure 3.3 is applied in career blasting.

After application of this technology behind it was noticed the disappearance of front crack, making a regular slope along the length of the front and resulted the reduction of oversized rocks after blasting.

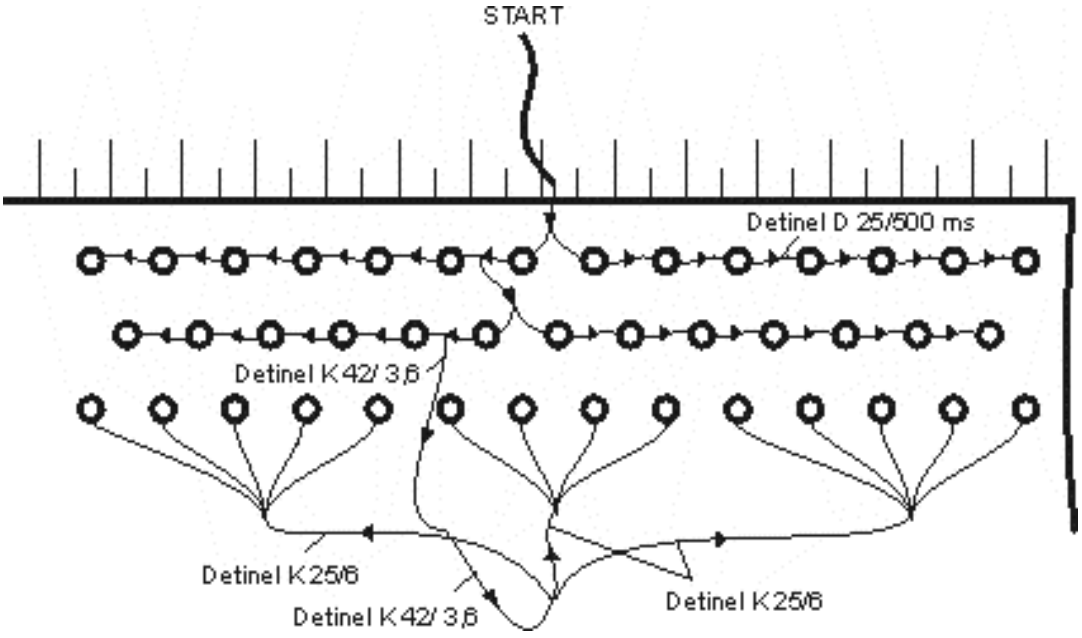

Figure 5. Blasting monography

Underground use of RIOGUR FCD explosives

RIOGUR FCD explosive underground testing was performed at Salina Ocna Dej, belonging SNS Bucharest, given the high production of salt is operated over a year and that is the complex salt in Romania.

Salt blasting technology in Ocna Dej is developed in quadratic form rooms, with a length of 15 m and a height of 8 m.

The main purpose of these tests was to see the behaviour and efficiency of explosive Riogur FCD 22 mm in the exploiting room contour area.

It was proposed a blasting scheme with parallel holes, using as base load Amonita E and for contour holes was used Riogur FCD 22 mm.

The main parameters of the blasting are:
- Total number of holes: 112
- Length of hole: 2,0 - 2,1 m
- Hole diameter 40 mm
- Base explosive: Amonita E (32x220mm, 200g/cartridge)

A quantity of explosive / hole: 1,0 - 1,2 kg
- Explosive contour: Riogur F-CD 22
- Ignition: Electric Detonators type Riodet S - millisecond

The load method of the mine hole is shown in figure 6 and the blasting schemle is shown in fig. 7

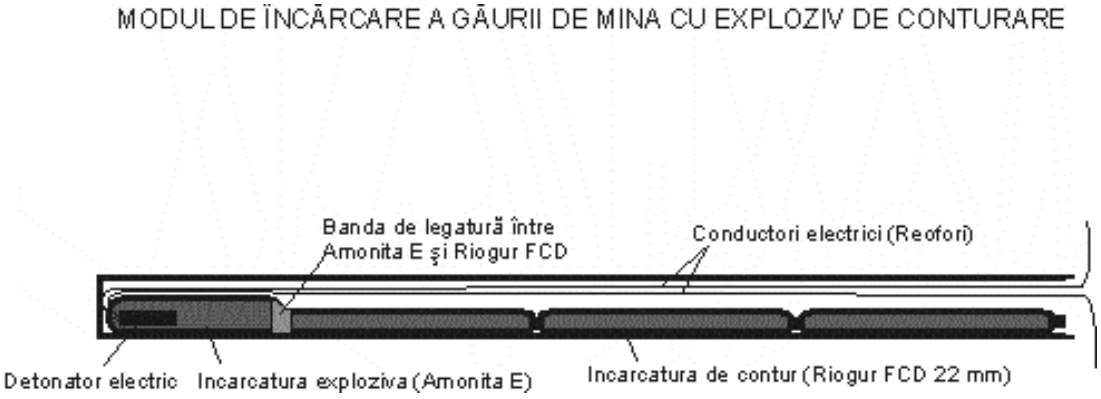

Figure 6

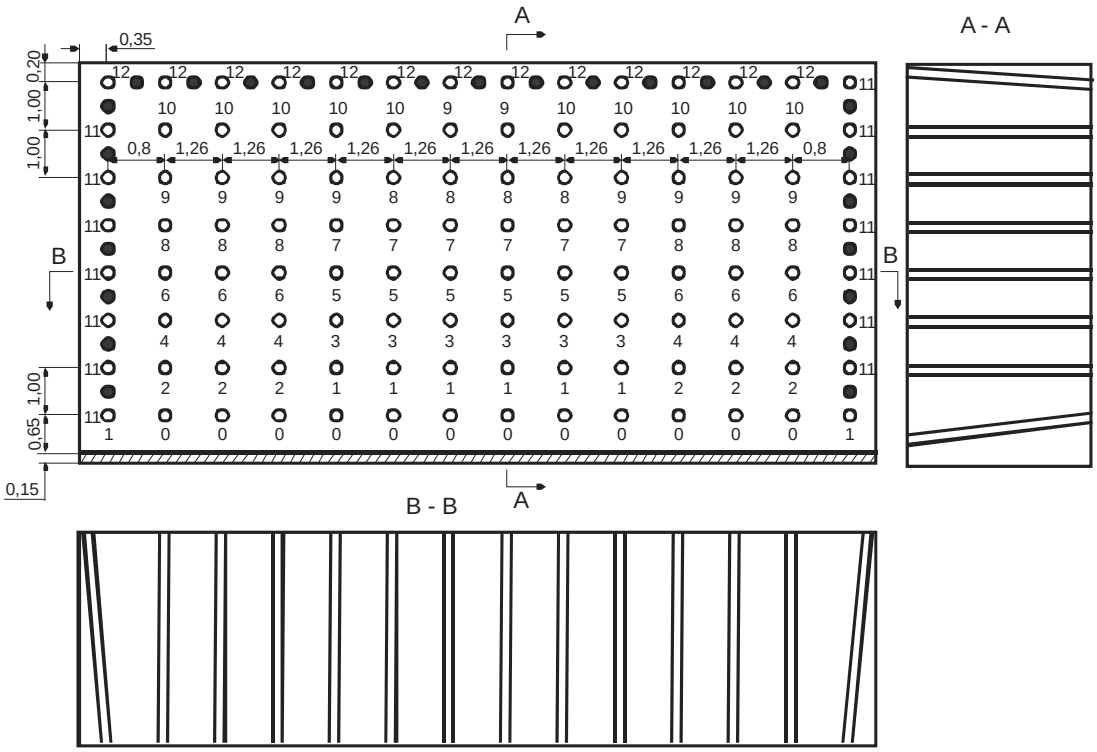

Figure 7. Blasting scheme with parallel mine holes

Conclusions

The use of Riogur F-CD explosive for contour holes results in a much better profile uniformity and a whole wall jump blast. Thus avoids the appearance of over or under profiling and as default correct sizing of pillar.

There were no black traces on salt to affect the organoleptic quality of salt in the holes contour area.

General conclusions

To minimize damage of the surface work slopes, damage to the gallery or tunnel wall or salt mining pillars where there are different ways of detonation that reduce their destabilization. It is obvious that these methodologies, normally lead to a higher cost of operation, although some can be recovered by the time gained would have been dedicated to cleaning the place after blasting.

An additional cost is not to be neglected in appearance of the over-profiling situation in underground works where necessary additional work to roof support or re-profiling, in which case further increase costs considerably.

Using Riogur FCD explosive in both blasting technology at the surface and underground showed that this product is a viable cost reduction solution.

It should be noted also that the use of this product helps to limit the effects of mining structures and also limits the effect on civilian objects or industrial blasting in the immediate neighbourhood of the mines.

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