PROCEEDINGS OT THE XI-TH NATIONAL CONFERENCE WITH INTERNATIONAL PARTICIPATION OF THE OPEN AND UNDERWATER MINING OF MINERALS

НАУЧНО-ТЕХНИЧЕСКИ СЪЮЗ ПО МИННО ДЕЛО, ГЕОЛОГИЯ И МЕТАЛУРГИЯ
SCIENTIFIC AND TECHNICAL UNION OF MINING, GEOLOGY AND METALLURGY
НАУЧНО-ТЕХНИЧЕСКИЙ СОЮЗ ПО ГОРНОМУ ДЕЛУ, ГЕОЛОГИИ И МЕТАЛЛУРГИИ

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BLAST DESIGN WITH OPTIMAL DELAYING INTERVALS FOR USE OF COMMERCIAL CARTRIDGES EXPLOSIVES AT BANJANI MINES –SKOPJE

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ABSTRACT

In this paper are presented some blasting series which are prepare with commercial explosives form Detonit - Trayal corporation. We give some characteristics of this explosives, ways of use and effects form this blasting series.
For use as a comercial explosive was prepare vocational expertise has been carried out for drilling parameters, hole charging mode and ignition pattern as well.
Using of commercial explosives is in a marbleized limestone media which are heterogeneous and compact with visible cracks and caverns typical for all kinds of limestones. From this reasons was maked and prepare some blasting series with different type of explosives and different blasting parameters.

Key words: explosives, blasting series, nonel - connectors, open pit mine

1.0 Introduction

For a longer period of time on the open pit Banjani for massive (bench) blasting of the blasting circuit commercial explosives produced in Greece and Bulgaria were used. By using of these explosives good production results have been obtained implementing drilling pattern a x b (3.75m x 3.5m).

During 2010 year and the beginning of 2011year it was started with use of explosives from another supplier Detonit Radovis produced in R. of Serbia, - Trayal Corporation, Krusevac.

1.1 Geology of the open pit mine

Open pit Banjani terrain is consisted of marbleized limestone (calcium carbonate with 95-98 % $CaCO_3$ as a main mineral calcite, quartzite, crystallized schists from the old paleozoik, sandstones, calcareous tuff limestones from neogen, terra rossa and debris materials.

Typical are occurrences of cracks and caverns with small sizes to some (cm) and crevices with the similar dimensions. Some of the cracks are filled with calcite and aragonite because of this calcite veins could be encountered up to 5cm in width. They are stratified in thick beds and sill shaped, layer form that is easy to notice on the surface is just apparent.

2.0. Technical characteristic of Detonit - Radovis commercial explosives

In the following table are shown characteristics of the Detonit Radovis commercial explosives which are used currently at Banjani mines AD Skopje.
Those are basic elements for further testing and considerations and ignition pattern defining.

Table 1

Characteristics of the Detonit Radovis commercial explosives

Description	Unit measure	AN-FO J1	Amonex 4
Dencity	g/m^3	0,85	1-1,05
Detonation velocity	m/s	2544	3200
Gap sensitivity	cm	/	4
Gas volume	dm^3/kg	751	1004
Explosion heat	Kj/kg	2964	3892
Explosion temperature	^{o}k	2218	2661
Traucl test	cm^3	/	310-330

Figure 1 Commercial explosive by Detonit Radovis
AN-FO J1(left) and Amonex 4 (right)

3.0. Blasting series characteristics

Drill holes for the blasting series are drilled on three different locations on the open pit Banjani with 200 - 400 m distance from each other and at elevation 610/590m. Drill hole size is the same for all locations (Φ105mm).

Table 2

Basic drilling - blasting parameters

Description	mark	Unit measure	Series 1	Series 2	Series 3
Distance between holes in a row	a	m	3.5	3.5	3.75
Distance between rows	b	m	3	3.5	3.5
Burden	w	m	3	3.5	3.5
Hole diameter	*Φ*	mm	105	105	105
Drilling angle	α	^{o}	85	85	85
Drilling depth	H	m	22	21.5	22
Bench height	H	m	20	20	20

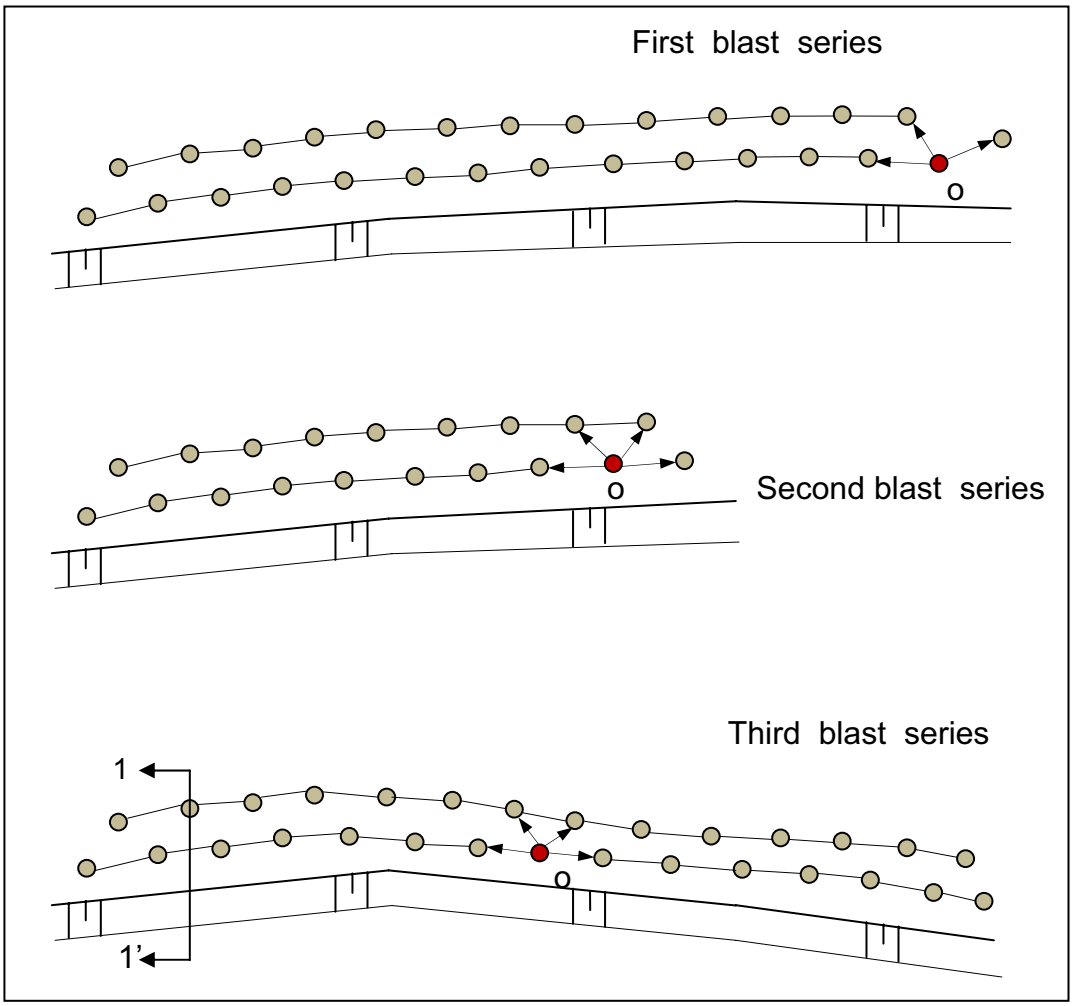

Figure 2 Blast design and way of initiation

3.1 Drillhole charging mode

Hole charging with commercial explosive is done according the regulations and for all three blasting series is different.

Charging ratio between AN-FO J 1DM and Amonex 4 with Φ 90 is shown in Table no. 3.

Table 3

Ratio between different type of explosives in the drill holes

Description	AN-FO J1	Amonex 4
Blasting series 1	63%	37%
Blasting series 2	58%	42%
Blasting series 3	45%	55%

On the bottom of the drilled holes 2 - 3 cartridges Amoneks 4 Φ 90 are placed than a booster T - 450 gr. with a fixed nonel detonator U 450 ms in it. Charging of the drilled holes is according the presented figures.

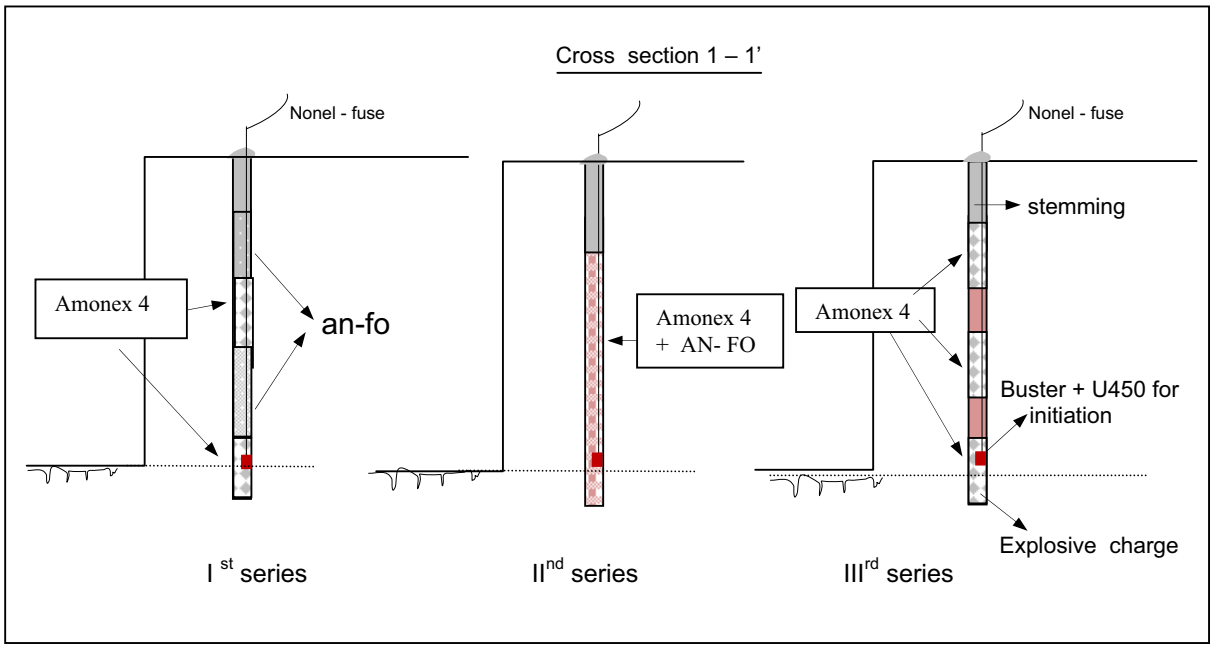

Figure 3 Charged hole profile of blasting series

Stemming/plugging of the charged holes was accomplished with the grinded material from the previous hole drilling and 3 - 3,5m in length depending from the quantity of placed explosive in the hole and the type of the rock massive (geology).

3.2 Mode of charged holes connecting in a blasting round

For determining the optimum delay interval between the charged holes in a row and delay interval between the rows in all three blasting series it has been decided Nonel Initiating System to be used.

Holes are drilled in two rows and in alternate position /checkmate.

There are many models /forms by many authors for defining delay intervals like A.N Hanukajev, Johonson i Langeforst, G.I Pokrovsij etc.

Factors that have influence upon the choice of charged holes connection in a blasting round are: strength of the rock mass, cracks that occurs in the adjacent hole vicinity, mode of hole charging multiple row blasting rounds etc.

Nonel connectors SL17ms were used in all three blasting series for connecting charged holes in a row and Nonel connectors SL 25 were used for connecting rows in a blasting round thus the free surface for the following charged hole is around 1,9m and between each charged hole optimum delaying interval is about 8-9 ms. Bearing in mind the fact that there is a settlement in the open pit Banjani vicinity it is a practice not to use delayers with bigger delaying interval than 25ms between each hole.

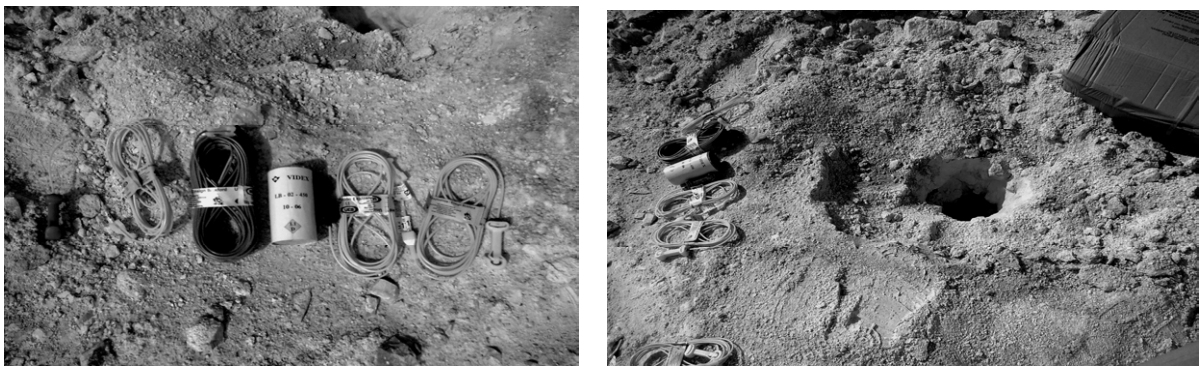

Figure 4 Nonel detonators with booster around drilled hole

4.0 Results from the executed blasting of the test blasting rounds

After each blasting of the test blasting series observation was made of the rock fragmentation and then loading was observed also which helped to reach the following conclusions:

-For the blasting round (series) no. 3 where the rock media itself is characterized with cracks which is likely to all limestones the amount of rock fragments with size bigger than 700mm x 700mm was in the range 8 -12% from the total blasted rock mass.

-For the blasting round no. 2 where the rock media is a heterogeneous with cracks interpellated with limestone schist and clay particles present in the overall limestone mass with thickness of around 1(one) meter the amount of rock fragments with size bigger than 700mm x 700mm was around 15% in the blasted rock mass.

-For the blasting round no.1 which is continuation of the blasting round no.3 with the same rock characteristics (geology) the amount of rock fragments with size bigger than 700mm x 700mm was in the range 3 - 5 % of the blasted rock mass.

View of the site before blasting | Blasting | Rock fragmentation after blasting

Figure 5 Photos from the series

5.0 Techno - Economic part of the subject

Economic part of the subject is presented in table 4 as a comparison between the commercial explosives with origin from R.Bulgaria (Amonit 6) and R.Greece (AN-FO), and with commercial explosives from Detonit-Radovis (Amonex4 I AN-FO J1) Produced in R. Serbia (department in R. Macedonia).

Table .4

Techno - Economic parameters of blasting series

Parameters	Unit measures	Comercial explosive Detonit.-Radovis.		Com. Expl. R.of Bulg. R.of Greece.
		Blasting series No.1	Blasting series No.2	Blasting series No.3
Holes spacing (axb)	m	3,75 x 3,5	3,5 x 3,0	3,75 x 3,5
Number of holes	pcs	30	32	30
Blasting field (L x B)	m	112x7	112x6	112x7
Totally drilled lenght, L	m	660	704	660
Holes depth, H	m	22	22	22
Explosives consumption, p	kg/m	7,5	7,5	7,6
Total explosive consumption, Qe	kg	4950	5280	5050
Blasted rock mass in tons, G	ton	21026	17942	21026
Specific explosive consumption, q	kg/t	0,235	0,301	0,240

6.0 Conclusion

Before each blasting the following should be done:

– Detail geological surveying of the rock profile with cracks, caverns, schists and clay particles defining and geological mapping to be done.

For the rock media where there are cracks, caverns as well clay ingredients commercial explosives with bigger gas volume should be applied or other explosives with smaller detonations/ brisants, and explosive initiation should be done from the bottom of the hole by Nonel detonator and a booster.

– For decreasing the amount of oversized blasted fragments where in the rock media there are cracks and caverns application of idle stemming with length from 0,5 m to 1 meter would be desireable and connecting of the explosive charges between the idle stemmings with detonating cord.Initiation of the explosive charge to start from the hole s bottom by Nonel detonator fixed to a booster.

– Drilling holes with smaller diameter (89mm) and using only powder explosive Amonex4, also decreasing the hole spacing.

– Drilling pattern to be done in two or three rows and initiation of the blasting round to start latteraly, from both ends of the blasting round by using Nonel connectors SL 17ms between the holes in a row, and SL25 between the rows.

Literature

[1] Dambov R., (2011), Methods of Blasting, Textbook, University "G. Delcev", FNTS, Stip, R. Macedonia

[2] Trajkovic S., Slimac S., Lutovac S., (2005), Blasting technics and ground schocs, Textbook, RGF, University of Beograd, Serbia

[3] Stig O Olosson, (2001), Applied explosives technology for construction and mining, Book, Applex AB P.O. Box 71, S-64043 Arla, Sweden

[4] Purtic N., (1991), Drilling and blasting, Textbook, RGF, University of Beograd, Serbia

[5] Journals "Blasting", "Miloje Zakic", Krusevac, Serbia

[6] Main mining project for ore exploitation, (1995), Rudproekt, Mines"Banjani", Skopje, R.Macedonia