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# APPLYING OF EXPLOSIVES OF THE TYPE AN-FO AND SLURRY IN THE OPEN PIT MINE "BUCIM"

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**SUMMARY:**

*In this paper shows the way of application of ANFO and SLURRY bulk explosives and blasting methods that are characteristic for this open pit mine.*
*According to the physical - mechanical characteristics of the working environment and condition of the blast hole are defining some parameters for each series separately.*
*In this open pit are defined 5(five) different working environments - rocks with copper mineralization (0,25%Cu) or rocks waste. According to the effects of blasting are make certain corrections in the quality and quantity of the explosives, the amount of explosive charge and geometry of the drilling.*
*We will presented basic drilling - blasting parameters for different types of explosives and some effects of landmines series in terms of granulation received, consumption of explosives and other normative material, impact on the environment and others.*

**Keywords:** working area, blasting parameters, bulk explosives, granulation

## 1. INTRODUCTION

For normal production for this tipe of open pit mine must to use diferent explosives for blasting. This mine , "Bucim" Mine, is situated in the south – eastern part of Rep.Macedonia in the south – western part of Plackovica Mountain.
The gold and silver amount in the copper concentrate are very significant and because of that, it's called copper, gold and silver mine.
Surface mining method is used in the excavation of the copper with benches 15 meters in hight.
The surface mining capacity for ore and waste is ~15 mill. tons/year, the mining and geo-logical condition allow the application of massive bench blasts in ore and waste with maxi-mum (HBS) 1150 mm ore granulation.
The use of "AN – FO" and "SLURRY" explosive mixtures is preformed by shunting station after "nalim" system, whose base is close to the pit.

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## 2.0 GEOLOGY AND PHYSICAL AND MECHANICAL FEATURES OF THE ORE DEPOSIT

This copper deposit belongs to the Bucim – Damjan – Borov Dol ore district formed between two large geotectonic units. The Serbo – Macedonian massif and the Vardar Zone.
The ore mineralization is of porphyry type and the copper mineralization appears in gneisses and amphibole-biotite schists. Chalcopyrite is the basic mineral in the copper ore together with pyrite, magnetite, chalcite etc.
Lot of ore bodies have been determinate in Bucim deposit: Cukar I, cukar II, Vrsnik, Central Part, Nord-Ist part and Bunardzik.
The Central Part is still in operation and "Cukar","Vrsnik" and Nord-Ist part. The ore body Bunardjic is new ore bodies and this reserves are in the stage of investigation. The copper content varies from 0.1 to 0.55 % Cu. Gold and silver are also present in small amount but sufficient for their economic value.
The main petrologic members have beeh conditionaly classified into three types: andesite, gneiss and ore in the drilling – blasting works.
The essential physical – mechanical features have been shown in Table 1*

| **Physical- mechanical properties** | **units** | **Ore** | **Andesite** | **Gneiss** |
|---|---|---|---|---|
| Mass volume | $g/cm^3$ | 2.78 | 2.67 | 2.6 |
| Porosity | % | 1.2 | 2.01 | 1.36 |
| Pressure strenght | $daN/cm^2$ | 1289 | 1226 | 1148 |
| Elongation streight | $daN/cm^2$ | 140 | 149 | 121 |
| Specific cohesion | $daN/cm^2$ | 241 | 234 | 203 |
| Angle of internal friction | $[^0]$ | 52 | 50 | 52 |
| Modules of elasticity | $kN/cm^2$ | 4464 | 3532 | 4462 |
| Speed of longitudinal waves in the massif | m/s | 2600 | 2550 | 2600 |

**Study of the geomechanical and hydrogeological features in Bucim deposit, 1971, M.I. – Belgrade*

Table 1: Physical – mechanical features

## 3.0 GENERAL FEATURES OF THE DRILLING – BLASTING OPERATION

The run – of mine copper ore is extracted by blasting of deep mine holes in waste and ore. Drilling is carried out by DM-6 and DMM drillmasters, produced by Ingersoll – Rand with borehole diameter of 250 mm. Blasting is done by the use of classical explosives mixtures of AN-FO and SLURRY and cartrige AN - explosives.
The necessity to carry out large number of massive blastings with the use of large amount of explosive entailed the use of improved way of filling and powerful explosives.
The relatively deep mine holes ( 16-18 m), the large drilling diameter (250 mm) , the use of cartridges with large mass, the frequent failure in the blasting series and the unpractical accomplishment in the blasting operation entailed the application of AN-FO and SLURRY blasting mixtures. For initiation in use is Nonel - sistem with diferent elements and delay detonators.

The accomplished analyses show that almost in all segments of the drilling-blasting operation the use of AN-FO and SLURRY mixtures in Buchim mine conditions have given very good results, first of all the tehnical – technological ones (fig.1).
The drilling geometry with the same borehole diameter has increased which means a smaller number of diggings per unit mass. This results in lowering the drilling costs, men's expenditures when drilling and blasting (with NALIM system of fillng, the filling speed of 100 kg/min of explosive per borehole is reached).
The specific consumptation of explosive which results in a small percent of nonstandard dimensions and their presence depends upon the existence of tectonic disorders of individual microlocations.
Some experience data and results from the use of an-fo and slurry mixtures are presented as follow.
The AN-FO mixtures is placed in dry bore holes according to "NALIM" system which means forming the explosive in the borehole itself. (Fig. 1)
SLURRY – mixtures are of "MAJDANIT" type and are used in a similar way. Their use has proved the advantages which painted at in their theory like:

- the density of the explosive allows to reach maximum meter charge density in the borehole;
- It is possible to regulate the energy features of the mixtures by the borehole heigh according to the physical – mechanical features and the drilling geometry, operation and initation safety;
- high water resistence;
- the degree of borehole volume recovery is maximum, and better contact between the explosive and the surrounding rock has also been attained;
- the possibility to carry out massive blasting where the boreholes are charged for several days and the explosive properties remain unchanged;

The above mentioned points show that SLURRY – mixtures have more advantages. It also means that in future this type of explosive mixtures in this open pit mine, with increased presence of underground water, will be most appropriate.

ANOL - ANFO SLURRY - M-10

Fig.: 1 The way of pumping of explosives miktures

## 4.0 SERIES OF MASS BLASTING BY THE USE OF AN-FO AND SLURRY EXPLOSIVES

A blasting series with 47.500 tons explosive was carried out during the regular operation. It was carried out in a andesite, of bench block 645/660 on the ore body "Vrsnik".
The accomplished drilling – blasting parameters and the result have been given as foloow.
Serie N$^{o}$ 660/645, Date:23.05.2012, RT Vrsnik, DM-50, BE45R

Number of boreholes…… 115
Drilling angle ($^{0}$)……..……90
Bench heigh (m)…… 15
Drilling diameter (mm)…… 250
Burden (m) ……..……. 9
Distance among boreholes (m)……..… 6
Distance among rows (m)…….…….... 6
Mine bore hole depth (m)……..….... 16,5
Stemming (chips)……..…. 6-8
Amount of crashed mass per hole (m$^{3}$) …..……. 667
Total amount of crashed (m3)……..… 76705
Rock mass (tons) …… 207103
Total consumption of AN-FO+SLURRY (kg)…… 47500
AN-FO (kg)…….. 17500
SLURRY (kg)……30000
Accomplished specific consumption (kg/m3)…… 0,62
(gr/t)…… 230
Total consumption of Nonel det. (U-500) …..……. 115
Consumption of Nonel-con. Sl0/7,8, Sl25/7,8,Sl42/7,8, Sl67/7,8
Busters (TNT - 500g) …….. 230

The initation of the series was non - electric, with nonel sistem of initiation and the way of dumping the series was on one side with diagonal - symmetric pattern of row dumping.
The part of this series of the blasting rock mass have been given in Figure 2.

Fig. 2 View of open pit mine with part od blasting series 645/660

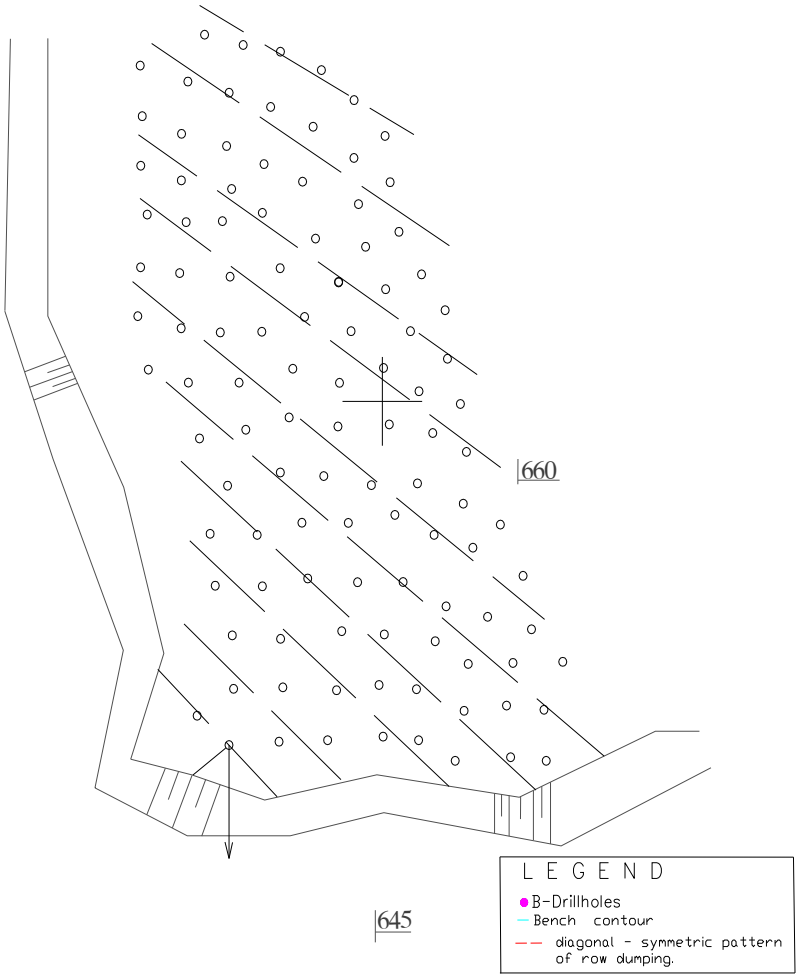


Fig 3: Blasting series 645/660 with main of blasting parameters

### 4.1 GRANULATION

The change of certain drilling – blasting parameters, their influence on the granulometric composition, the size of meddle portion, the state of bench slope behind the blast series are analyzed.

A lot of blasting series characteristic in this open pit was been analyzed. The series was of the same drilling – blasting parameters but only the specific expenditure of blasting material is changed. (Fig. 4)

The predicted values for the distribution of the granulation of the blasted material indicate that the blast series with this drilling - blasting parameters are given much better results but the consumpstion of explosives is hight. In the next time we must organized drilling blasting series with bigger patern distance (7 x 7m).

Investigations in granulation prediction in blasting are directed towards optimal definition of parameters of drilling and blasting such as:

- optimum granulation of ore mass blasted,
- minimum expenditure of explosive (accounting for 80% of the total blasting costs).

Establishing correlation between the parameters mentioned is a challenge for scientists and engineers in this spacific field. In that regard numerous experiments have been performed consisting of changing the parameters such as the smallest resistance, the distance between drill-holes, height of benches, specific explosive expenditure, ratio between hight of benches and burden etc.

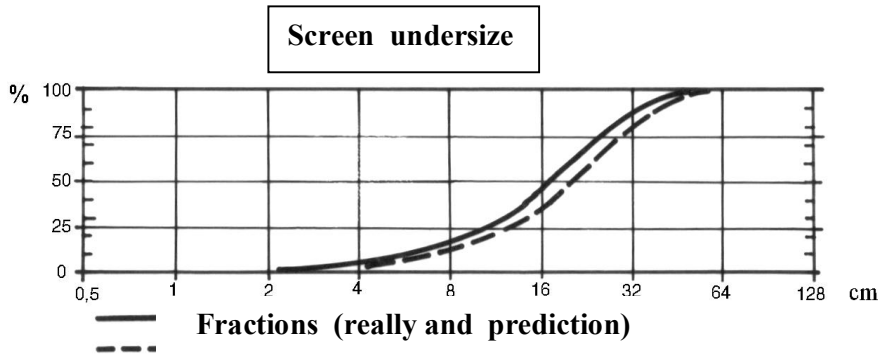


Fig.4: Percentage distribution of screen size in blasting series

## CONCLUSION

It was concluded that the use of explosives mixtures increased amount of blasting explosive is used at the Bucim open pit owing to the type of explosive used and its distribution according to hole depth (kg/m) and distribution pattern ($kg/m^3$). Increase of the drill hole pattern and the use of inter plugs are recommended. It would decrease the specific expenditure of explosive (20 to 30%) and would produce larger meddle portions in the blasted material (10 to 15%). This would also result in increased expenditures in primary crushing by 5 to 10%.

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