SETTING THE DRILLING – BLASTING PARAMETERS DEPENDING ON THE GEOMECHANICS OF ROCKS

ARAD VICTOR[1], ILIAS NICOLAE[2*], ACHIM MOISE[3], ARAD SUSANA[4]

[1,2,,4] University of Petrosani, University street, nr.20, Petrosani, Romania

[3] University „1 Decembrie 1918" Alba Iulia, Gabriel Bethlen street, nr.5, Alba Iulia, Romania

Abstract: In order to improve the performance of mine workings development technologies is necessary to establish optimum process parameters for drilling - blasting operations, as a function of the geo-mechanical characteristics of rocks.
The most important condition for successful drilling - blasting operations, with respect to the technical, economic and safety point of view, is a realistic projection of their choice, both in terms of explosive materials and concerning the operating parameters.
The most important characteristics of rocks which give guidance on the excavation by drilling - blasting are: compressive strength and abrasiveness of rocks.
The paper deals with the speed of drilling and explosive specific consumption for the two strength characteristics of rocks.

Keywords: drilling – blasting parameters, geomechanical characteristics.

1. SETTING THE DRILLING SPEED

The blasting holes drilling speed is a function that depends on the compressive strength and abrasiveness of rocks.

Based on laboratory tests on the geomechanical characteristics of rocks, and „in situ" drilling speeds in these types of rocks, were estimated by statistical calculation, from processing of the 2825 equations [1, 2]. The values of the drillings speed, abrasion and geomechanical characteristics of rocks are presented in Table 1, column 3.

Correlation equation, equation (1) showing the highest correlation coefficient and a good confidence interval of error for the change in penetration rate, according to rock geomechanical characteristics is shown in Figure 1.

$$y = a + b.x + c.\ln x/x^2 + d/x^2 + e.e^{-x} \quad (1)$$

where :

y – drilling speed ;
x – compressive strength;
a, b, c, d, e – statistically determined parameters.

There are also calculated the confidence intervals for predictions, together with the t coefficient and from the Student distribution, the relative frequency equation F.

* Corresponding author, email: iliasnic@yahoo.com

Table 1. Drilling speed, abrasion and geomechanical characteristics of rocks.

Crt. nr.	Compressive strength, σ_{rc} [MPa]	Drilling speed, V [m/min]		Abrasion coefficient	
		Realized	Estimated (Rel.1)	BOHME	BARON [mg]
0	*1*	*2*	*3*	*4*	*5*
1.	10	1.7	1.7	0.593	0.01
2.	15	1.6	1.667	0.55	0.07
3.	16	1.55	1.452	0.575	0.12
4.	17	1.3	1.286	0.572	0.15
5.	18	1.12	1.158	0.571	0.15
6.	19	1.1	1.057	0.568	0.2
7.	20	0.89	0.978	0.565	0.25
8.	30	0.75	0.689	0.54	0.31
9.	40	0.7	0.643	0.512	0.89
10.	50	0.55	0.624	0.485	2
11.	100	0.48	0.478	0.35	5

2. DETERMINATION OF OPTIMAL CONSUMPTION OF EXPLOSIVE

Knowing the optimal explosives consumption is extremely important both technically and environmentally.

The specific consumption of explosives is a very complex function because of the massive cracking phenomenon is a dynamic and dependent on several disruptive factors, both natural and technical [2, 3].

With a view to address the phenomenon in general, by the assessment of pre-conditions, there were used the equations known from literature.

Research conducted in the Romania and abroad, highlighting the dependence between the specific consumption of explosive and geomechanical characteristics of the rocks, depending on the setting static conditions of the phenomenon.

In order to determine the specific consumption of explosives is necessary to know the following parameters: the compressive strength of rock breaking or Protodiakonov's strength coefficient and the coefficient of equivalence of the explosive e_{TNT}.

The specific consumption of explosive can be determined on the basis of relation (2).

$$q = (0{,}182 + 0{,}0235 \cdot f)/e_{TNT} \tag{2}$$

From the results of laboratory tests and measurements in situ, synthesized in Table 2, it was obtained from 100 statistical processing of simple equations, the correlation between the specific consumption of explosive and Protodiakonov's coefficient, equation (3).

The correlation equation (3) is a power equation with the following coefficients: a, b and c determined statistically.

$$y = a + bx^c \tag{3}$$

where :

y – the specific explosive consumption function;

x – Protodiakonov's strength coefficient.

Table 2. Specific explosive consumption.

Crt. nr.	Protodiakonov coefficient f	Specific explosion consumption q [kg/m^3]		
		Analitical (eq. 2)	Realized	Estimated (eq. 3)
0	*1*	*2*	*3*	*4*
1.	1	0.28	0.295	0.2828
2.	1.5	0.296	0.3	0.3465
3.	1.6	0.299	0.35	0.3570
4.	1.7	0.303	0.36	0.3669
5.	1.8	0.306	0.4	0.3764
6	1.9	0.309	0.4	0.3854
7.	2	0.312	0.42	0.3941
8.	3	0.344	0.45	0.4648
9.	4	0.376	0.5	0.5177
10.	5	0.408	0.58	0.5604
11.	10	0.569	0.7	0.7025

3. CONCLUSIONS

Statistical and practical interpretation of the data obtained, lead us to several conclusions:

- From the results presented in Table 1 and compared with values determined by calculating the correlation function it can be seen that the projected drilling rate is very close to that obtained in practice, the maximum difference being 10%;
- It appears that speeds achieved are generally lower than forecasted, because of correlation in the relationship (1) does not take into account a number of factors such as human factors and technical equipment;
- From Table 2, one also notes that the value of specific consumption of explosive analytical determined is very close to that estimated, given by the correlation function, and is also closet o the realized value. Errors occur at a 99% confidence interval, obtained from both data processing errors and the approximation of the model simulated phenomenon;
- The graphs presented in Figures 1 and 2 show the evolution of values analyzed and also can get the value of the function at any point;
- Drilling speed variation and the specific consumption of explosive were determined, as a function of the geomechanical characteristics of rocks.

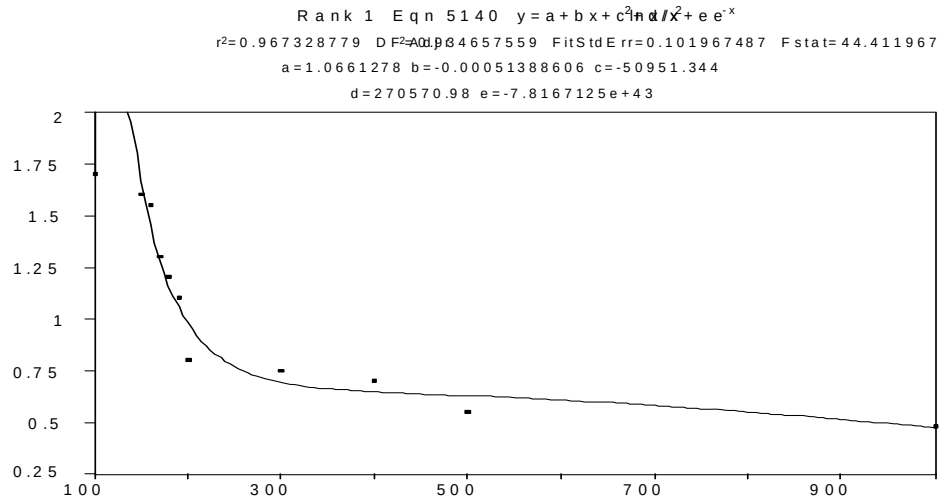

Fig. 1. Drilling speed variation depending on the compressive breakage strength [2].

Results from research undertaken for more perimeters and laboratory examinations performed in the Geomechanics Laboratory at the University of Petrosani allow us to appreciate that this research can be generalized for different types of rocks.

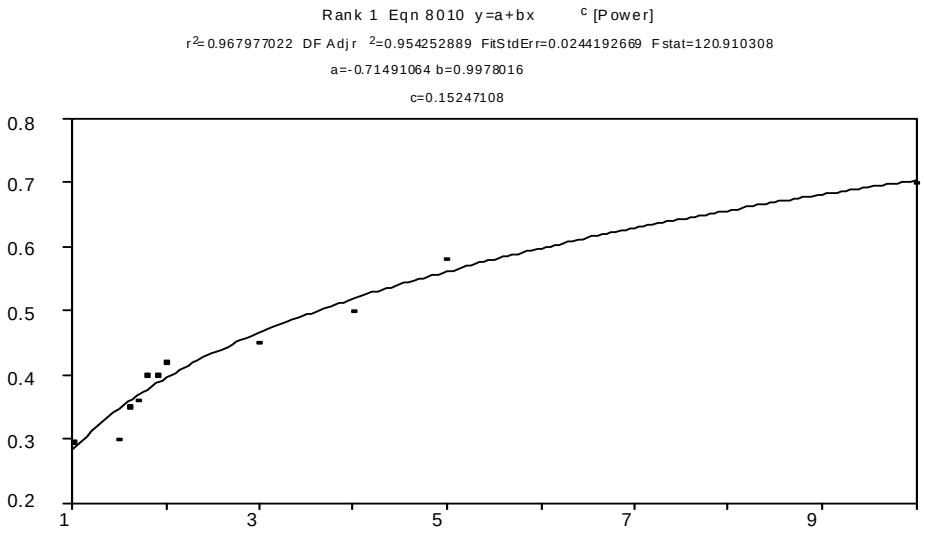

Fig. 2. Explosive specific consumption variation depending on the strength coefficient [2].

REFERENCES

[1] Arad, V., Geomecanica, Editura Tehnica Info, Chisinau, 2009.
[2] Arad, V., Mecanica rocilor saline , Editura Focus, Petrosani, 2008.
[3] Arad, V., Geomecanică minieră. Editura Tehnică, Bucureşti, 1995.