MINE WATER. GRANADA, SPAIN. 1985.

THE IMPORTANCE OF PROTECTION THE OPEN CASTS FROM UNDERGROUND AND SURFACE WATER CONCERNING SLOPE STABILITY ASPECTS

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ABSTRACT

Drainage in mineral materials surface exploatation is an extraordinary fase in tehnological process.

In some of the working medias the exploatation is completelly stipulated by the protection system efficiency from surface and underground water, which is directly relating on slope stability, bearing capacity, adhesiveness, digging resistence, etc.

This Paper considers the problems of groundwater and surface water influences of slope stability illustrated by concrete practical data.

PROBLEM INDICATION

The open casts protection of groundwater and surface water has twofold aimes. The first one-physycal presence of water in the open cast region makes impossible normaly development of tehnological process in the terms of classical, convencional exploatation, excepting the submarged exploatation of mineral

materials. The second one-the water presence in the working media more or less degrade its geomechanical properties. The alteration of geomechanical properties of working media has a direct effect on bearing capacity, adhesiveness, digging resistence, slope stability etc.

This article is treating the problem of water influence on slope stability. To ours mind, this problem is extremely significant, as from security exploatation aspect and techno-economical aspect, as well. In phylosophical sense those two aspects are opposite to each other: as the slope with minor angle means greater working security, very often it means more expensive production, because of waste rock increasing quantity. The engineer task is to ballance those two opposite requests, by defining the rational angles of the open cast slopes,respecting the limitation factors.

The indicated problem by it's complexity, surprasses the range of this work, so that through the example of one coal open cast, in condensed form, point the importance of protection from surface and underground water, concerning on slope stability aspect.

WATER EFFECT ON SLOPE STABILITY

The waste rock overbourdon of the treating coal layer consists of clay materials. By series of field and experimental laboratory testings, gained the data of changing the angle of internal friction (φ) and cohesion (C) in function of moisture content (W). By computerising of these data the collerelative functions gained as follows:

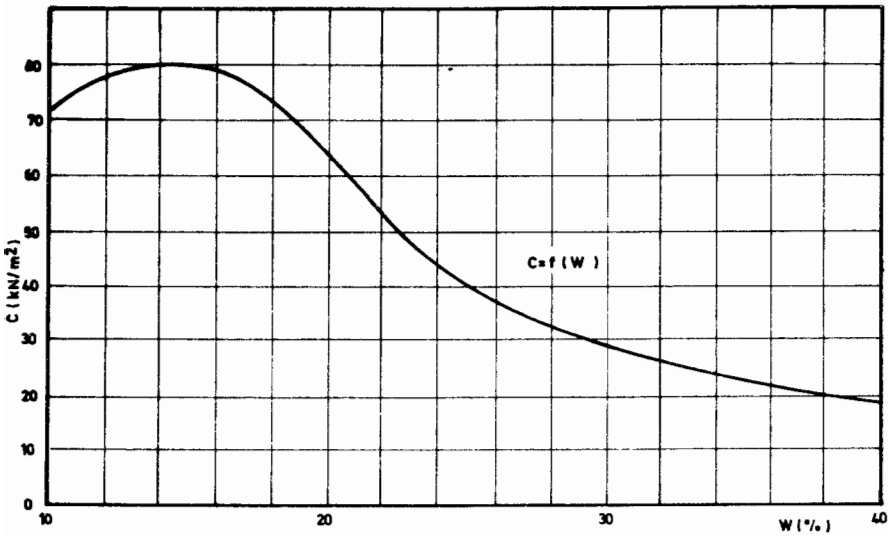
$$c = f(w)$$
$$\varphi = f(w)$$

In the form of polynome it would be:

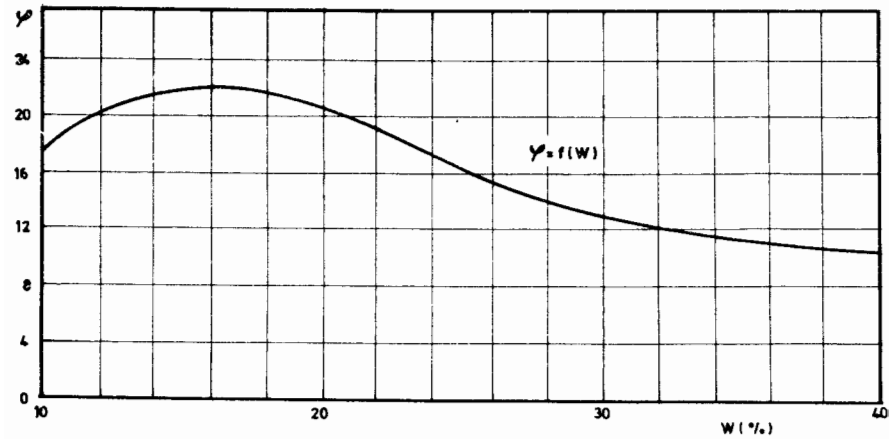
$$c = 59{,}79 + 11{,}91\ w - 0{,}645\ w^2 - 0{,}622\ w^3 + 0{,}097\ w^4 - 0{,}0053\ w^5 + 0{,}00001\ w^6;$$

$$\varphi = 13{,}95 + 3{,}99\ w - 0{,}396\ w^2 - 0{,}058\ w^3 + 0{,}0099\ w^4 - 0{,}0005\ w^5 + 0{,}0000083\ w^6$$

On figure 1 is shown the graphyc of function c (w), and on figure 2 ih shown the function $\varphi(w)$.



SL. 1.



SL. 2.

The degree of function accuracy c(w) is 99,94% and for the function $\varphi(w)$ is 99,98%. These values indicatively show great dependance between the researching parameters.

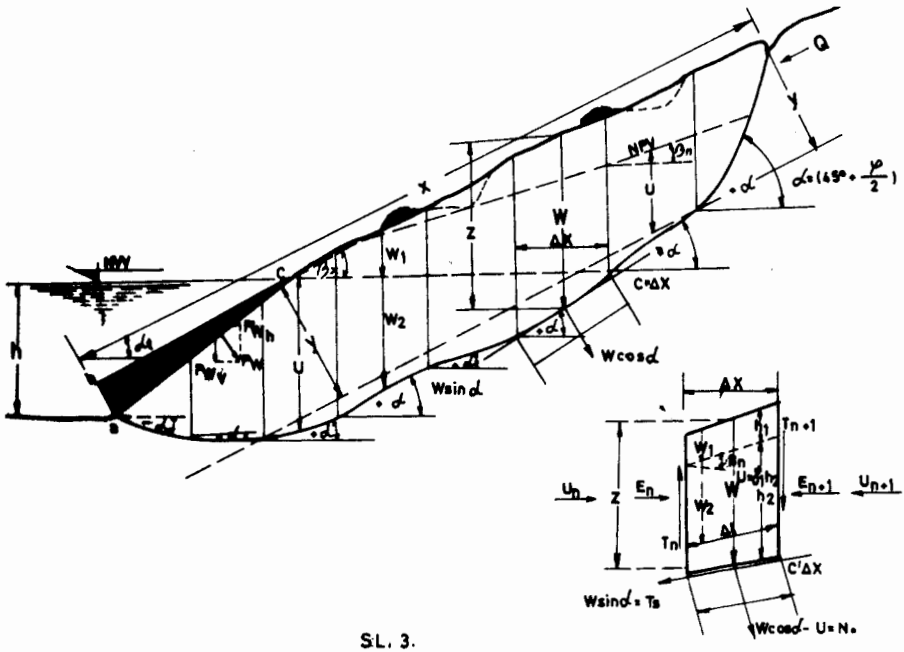
Applying the method by T.Todorović in further investigations for slope stability calculations, series of general open cast stability calculation was done, in order to make correlation between the slope stability factor and moisture content.

$$F = f(w)$$

To the method proposed by T.Todorović, slide surface has to be of any form but with respecting the action of filtrating forces, intertial seismical forces, pore pressure and eventually the hydrostatic water pressure.

On fig. 3 is shown the grafic presentation of force analysis based on the method by T.Todorović. The essential analitical expression for calculating the security coefficient by this method has the following shape:

$$F_s = \frac{\sum_{i=1}^{i=n} Ci\,\Delta xi + \sum_{i=1}^{i=n} (W_1 + W_2 - Ui\,\Delta xi)\cos\alpha i \cdot \operatorname{tg}\varphi i'}{1 + \sum_{i=1}^{i=n} [(y/x)\operatorname{tg}\alpha i(\alpha i/\alpha t)\operatorname{tg}^2(45 \pm \varphi/2)]\,Ko}$$
$$\sum_{i=1}^{i=n} W \sin\alpha i \pm W \sin\alpha i \cdot \gamma v E i \operatorname{tg}\beta i + W \sin\alpha i \cdot 2Ks \pm Qi$$

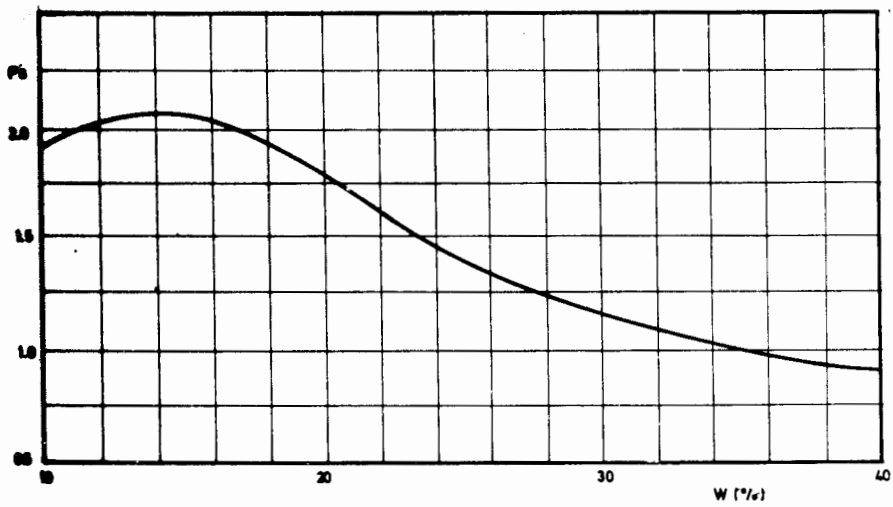


S.L. 3.

For the variance moisture content in the range of 10 to 40% a series of geostatic calculations for slope stability of the open - cast was done, and the following functional connection between the slope stability coefficient and moisture content of the working medium was found out, as follows:

$$F = -2.975 + 0.937w - 0.0527w^2 + 0.000447w^3 + 0.000446w^4 - 0.00000137w^5 + 0.0000000117w^6$$

On the fig. 4 is shown the grafic of the function F (w). High level of correlativity between the numerical values stability coefficients and moisture content (99,8%) points on the close functional relationship and direct dependance the stability open cast slope from the moisture of working medium.



SL. 4.

Those experimental - theory investigations confirm the already known fact that water presence degrade geomechanical properties of working mddium, but in the same time they point the transformations of open cast slopes from stabile to unstabile state and they are not so distanced in tho cases of undergrond and surface water presence.

LITERATURE

1. Ratković-Vujić M. - The results of geotechnical investigations from REIK "Kolubara" region The documentation fond of "Kosovoprojekt" - Belgrade.

2. Todorović T. - Terrain stability study under the conditions of underground water acting at the erosion region arrangement.