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ASSESSMENT OF QUALITY OBJECTIVES OF CAVED BENCH MINING METHODS

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ABSTRACT

The research has as main goal to assess the effects of the dynamic of basic qualitative parameters of mining products exploited, in the context of alteration of quantitative weight for the mining methods employed, consequently to the increasing scale operation with the use of caved bench mining method MEBS.

GENERAL CONSIDERATION

In order to approach, even synthetically, we consider useful to remind that the survival of an enterprise highly depends of his client's existence; to be able to maintain a client, it is required constantly to meet his more and more complex, evolutionary and exacting needs. Consequently, the industrial unit should constantly be in progress, being supported on the contribution of his personnel members from the quality department.

The quality management process consists in applying all the statistic principles and techniques in all the stages: design, production, operation and maintenance, in order to economically satisfy the demands.

To elaborate the quality characteristics for a product it will be employed the concept of optimization, meaning satisfaction both of client's and supplier's needs, with minimal cost prices.

MEBS – represents a process – "a systematic serie of actions directed towards reaching the coal exploitation from the deposit". The term "process" includes both the human factor and the equipment's and the environment, he accomplishes also the following criteria:

- *he is systematic:* the activities within the process are interconnected in a unique concept;
- *he detainees capability*: the final result of quality plans is a process which is able to reach the objectives concerning quality in given existing operating conditions;
- *is legitimate*: the process is developed through authorized paths; he will be approved by those to whom the assigned responsibilities were commissioned.

The quality objectives are issued from number of client's requirements and from the variable characteristics of mined out coal output and selected mine technologies.

Most of the quality objectives were established at bottom and mean levels of the hierarchy. Objectives are assesses very often on technological basis, expressed mainly by the ash content / qualitative parameter to be monitored by quality responsible and by workers.

The relationship between quality and selling a product are for the date, not enough understood, but the research work carried out are emphasising a direct connection between quality and benefits. The most efficient valorisation way for the mined out coal outputs, as far as the maximal cash is concerned, is not yet approached in his whole complexity.

To prioritise quality, it must be taken into account whit maximal weight when estimating the managing skills and performances whit now are having as first goals. Overall physical mined out output and working efficiency in physical units.

ESTIMATING THE CAPABILITY OF THE CAVED BENCH MINING METHOD

The studied the mining method belongs to a group of new tehnologies applied in the collieries from Valea Jiului coal basin, so it is a process containing some characteristics over taken from former processes / for whom operational knowledge exist and certain characteristics not completed by practical experience. In the sometime, the mining method be considered as a critical process, presenting some specific occupational safety and environmental problems, but also the risk of loosing important amounts of money as a consequence of the lower process capability.

The caved bench mining methods are designed to provide an average output of 1500 t exploited coal in every working face.

The processes excessively variable are not able to complete their objectives regarding the quality.

While the method has as main goal the reaching objectives of efficiency and reaching the proposed outputs per working face, we are foreseeing that miners will deliberately ignore the quality checking in the tehnological processes.

The capacity of the process to active quality products has two aspects

- the ability to reach the objectives concerning the outputs quality the so called targeting (which is for the MEBS s case, to provide the standardised ash content).
- The intrinsic capacity to constantly repeat the results, known as the capability of the process.

The effect of excessive variations of ash content, as qualitative target parameter at working face level will be the probably expressed in a graphical manner, using a diagram, as it follows (figure1).

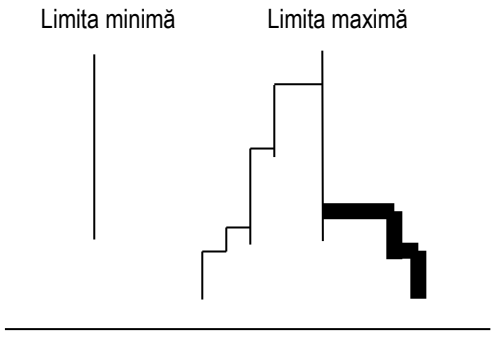

Figure 1

The mining process is characterised by the tendency allowable limit of ash content, in order to achieve the quantitative parameters.

A consequence according to the diagram consists in frequent exceeding of the allowable ash content with major effects regarding these products valorisation.

Regardless from the characteristics token over from methods usually employed in Valea Jiului coal basin mining practices, MEBS obviously dispose of new characteristics, for whom there is not yet experience and knowledge, for example coal outputs quality.

The measurement of coal quantity exploited from cased bench mining method, together with his quality expressed in ash contend are representing actual issues not completely solved out yet. Determination as accurate as possible the coal output and quality in comparison whit the reserve consumption from the considered deposit and seams ash content is having a real economical significance and importance given by the need to monitor technical and economical efficiencies of MEBS and also by requirement to measure the work and quantify the level of rewords.

Uncertainties on accurate knowledge of industrial product's ash content for every working place, affects negatively the try to rigorously analyse MEBS's efficiency, whit respect to recovery and dilution degrees.

A particular shape of process capability evaluation is the numerical simulation based on mathematical models.

For a first case study we employed the data specific for seam 13, block II, Lupeni colliery.

The main purpose of the case study consists in assessing a correlation between the qualitative parameters of mined out coal in high output working faces and castings volume expressed as marketable output. It is to be mentioned that an output of 1500 t day, as it is designed for the caved bench mining method represents for the great majority of collieries within our basin a weight exceeding 50 %, so the effects on coals quality delivered for coal processing plants or thermal powerplants will be major. The mathematical model and the results are presented in the following section

RESEARCH REGARDING THE POSSIBILITY TO EVALUATE MARKETABLE OUTPUT AS A FUNCTION OF THE QUALITY OF MATERIALS RESULTED THROUGH OUTPUT'S EVACUATION FROM THE CAVED BENCH.

The main parameters taken into account in this research were

a - ash content of material in the deposit, comprised between 6 - 38,5 %;

b - ash content of debris in the deposits roof comprised between 83 - 88 %;

v_a - the weight of coal from the seam in the entire coal output, comprised between 0 - 100 %;

v_b - weight of debris in the coal mass comprised;

w_c - moisture content of mined out coal comprised between 6 - 10 %.

As qualitative and quantitative index the marketable output is employed output resulted from selling the rough coal as sorted PM, lei Gcal

Description of the mathematical model proposed:

Using the following notations: Y = P.M., X_1 =a, X_2=b, X_3=v_a, X_4=v_b, X_5=w_c, the dependence between the six considered parameters can be described employing an equation having the shape:

$$Y = F(x_1, x_2, x_3, x_4, x_5) \quad (1)$$

Taylor polynoms, can be used for the approached issues:

The linear polynom whose shape is:

$$T_l = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 \quad (2)$$

Analysing the shapes of two degree Taylor polynoms we can observe that they can be turned in linear polynoms which are depending upon a higher number of variables namely:

a) For the quasicanonical polynom, by introducing the following variable $x_6 = x_1^2$; $x_7 = x_2^2$; $x_8 = x_3^2$; $x_9 = x_4^2$; $x_{10} = x_5^2$, T_c will take the shape:

$$T_c = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + a_8x_8 + a_9x_9 + a_{10}x_{10} \quad (3,a)$$

where: $a_6 = b_1$; $a_7 = b_2$; $a_8 = b_3$; $a_9 = b_4$; $a_{10} = b_5$;

b) For the general polynom, by doing these notations: $x_6 = x_1^2$; $x_7 = x_2^2$; $x_8 = x_3^2$; $x_9 = x_4^2$; $x_{10} = x_5^2$; $x_{11} = x_1x_2$; $x_{12} = x_1x_3$; $x_{13} = x_1x_4$; $x_{14} = x_1x_5$; $x_{15} = x_2x_3$; $x_{16} = x_2x_4$; $x_{17} = x_2x_5$; $x_{18} = x_3x_4$; $x_{19} = x_3x_5$; $x_{20} = x_4x_5$, T_g will admit the expression:

$$T_g = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + a_8x_8 + a_9x_9 + a_{10}x_{10} + a_{11}x_{11} + a_{12}x_{12} + a_{13}x_{13} + a_{14}x_{14} + a_{15}x_{15} + a_{16}x_{16} + a_{17}x_{17} + a_{18}x_{18} + a_{19}x_{19} + a_{20}x_{20} \quad (3,b)$$

Based on the above presented equation (1) will be completely determined precisely or approximately / if the Taylor polynoms coefficients T_l, T_c, T_g, having the shapes (2a), (3,a) and (3,b) will be determined. To obtain their values in real conditions N groups of seven values having the shape $\{ y_k, x_{1k}, x_{2k}, x_{3k}, x_{4k}, x_{5k} \}$; $k = 1 \leftrightarrow N$; with which, using the least square roots method some linear systems of q equations with q unknowns are obtained. For these systems:

-q=6 for the linear polynom
-q=11 for the quasicanonical polynom
-q=21 for the general polynim
and their solutions can be obtained by computer

Mathematical model's validity testing: The proposed mathematical models was achieved based on data gathered from technical reports available at collieries.

Table 1 synthesize the main values of the above mentioned parameters, employed in validation of mathematical models. For each case, the computation of Taylor polynoms coefficiency was made by computer.

Table 1

X_1	X_2	X_3	X_4	X_5	Y
6	83	100	0	6	398
8	84	95	5	7	367
10	85	90	10	8	335
12	86	85	15	9	303
14	87	80	20	10	282
16	88	75	25	6	253
18	83	70	30	7	233
20	84	65	35	8	191
22	85	60	40	9	173
24	86	55	45	10	155
26	87	50	50	6	147
28	88	45	55	7	110
30	83	40	60	8	104
32	85	30	70	10	62,0
34	87	20	80	7	30,2
35	88	15	85	8	19,1
36	83	10	90	9	15,1
37	84	5	95	10	5,2
38	85	0	100	6	2,6

The solution adopted in solving these disadvantages consisting in conceiving an original software, allowing an accurate computation of coefficients and to obtain correct solution of the equation's.

We note that the model can be applied when other parameters characteristics to the mining process are used, of course with appropriate alterations in the proposed mathematical model.

CONCLUSIONS

- The quality of mined out output should became a priority objective in high rank manager's responsibilities, in order to obtain maximal incomes from coal valorization;
- MEBS represents a new mining method, at least when considering the qualitative influences which should be known as a effects on cost prices and incomes;
- Applying MEBS changes the weight of coal mined out by different mining methods, with 50% including major consequences on coal's quality. In working faces exploiting coal by caved bench method an upper control limit and an upper tolerance limit had to be fixed and permanently monitored and acting so that they will be not exceeded.
- The proposed mathematical models established a correlation between the qualitative and quantitative parameters and their influence on the possible incomes. The model can be also employed when other characteristic parameters of the mining process are introduced, with corresponding alteration of the mathematical model;
- It is advisable and feasible to make expeditious interventions for quality correction at high output level working faces, if portable measuring devices and instruments will be available to rapid assessment of coals ash content;

- Correlation of rapid analysis data with proposed mathematical model considerably enables the obtaining of the economical effects of mined output's quality;

- The research carried out can be spread to other mining methods currently applied in the practice of collieries within the Valea Jiului coal basin.

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