CONSIDERATIONS ABOUT LONG WALL – MECHANIZED FACE TECHNOLOGY IN THE JIU VALLEY UNDERGROUND MINES

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Abstract: Within the classical method, the model of the technological face variant selection for a set of concrete layer conditions and the optimization of the face parameters is imposed.

But the high number of the equipment types and dimensions, such as: face mechanized support, face shearers and conveyers with the same technical parameters, allow the connection in a high number of machine complexes and their use for a certain set of given conditions that describe a coal layer.

The paper realizes the optimization models in which to pursue not only the variability of input factors but also their controllability.

Keywords: mechanized complex, system, method of last squares, production, advance speed

1. INTRODUCTION

In the Jiu Valley, the trend of coal in long wall-mechanized complexes slaughter is constantly increasing. Because of the geological mining conditions, coal exploitation with mechanized complexes, raise real economic and technical problems.

Mechanized complexes operation analysis show a production decreasing of 40 – 50 % because of strata technical characteristics and conditions of exploitation. By this reason, often mechanized complexes are dismantled before the reserves of the field of slaughter, respectively.

Efforts are needed to see how far it can go on to blame geological-mining conditions. Production processes are working in an entry specifically known as a

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reserve operated. In particular, each hewing to this factor is an input portion of the layer to exploit through several stages: stage performance of work mining preparation, stage equipment installation and maintenance of utilities, exploitation stage itself, the stage of withdrawal of equipment, materials and subassemblies used to isolate and stage area.

Research operation in the state operation system itself, using systems theory, allows us to realize the optimization models in which to pursue not only the variability of input factors but also their controllability.

2. CUSTOMIZING SYSTEMS THEORY IN THE CASE OF LONG WALL - MECHANIZED COMPLEX TECHNOLOGY

The developed model is one of input-state-output. The so called ARARX means that the perturbation is modeled as an autoregressive process and the system dynamics is described by an ARX model. The advantage of such a model will be underlined in the use of generalized of least squares method. Once obtained the long wall - mechanized face mathematical model, it can realize an optimal control, to achieve, under certain conditions, the maximum production.

An application of this model was made into a long wall - mechanized face at Lupeni coal mine and the simulation attended 12 month taking into account the data from table 1.

Table 1. **Production indicators at the Lupeni coal mine**

Nr.crt	Months	Average daily (m/day	Net Production (tons/day)
1	January	1,3	1150
2	February	1,3	989
3	March	1,5	1053
4	April	1,3	830
5	May	0,6	442
6	June	1,4	953
7	July	1,2	848
8	August	1,0	649
9	September	0,8	554
10	October	0,9	576
11	November	1,1	418
12	December	1,4	557

In figure 1 it can be observed that at a speed of front advance of 1.5 m / day in March was obtained a production of 1053 tons / day, while at a speed of front advance of 1.3 m / day in January was obtained a production of 1150 tons / day. Also it can be seen that in June at a speed of front advance of 1.4 m / day was obtained a production of 953 tons / day while at the same speed but in December, the realized production does not exceed 557 tons / day.

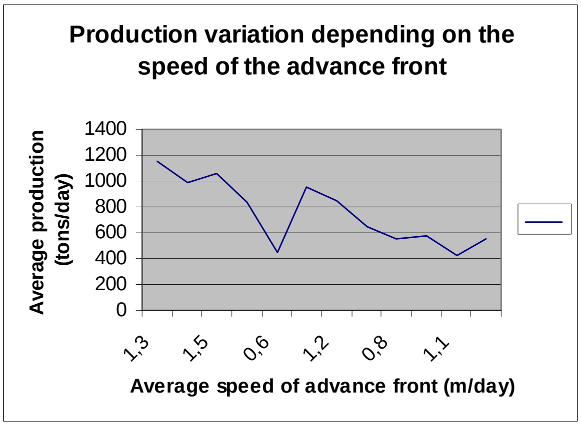

Fig.1. The production variation depending on the front advance speed

We studied the case in which was considered as entrance factor the speed of front advance (m / day), and as exit factor the daily medium production (t/day) (fig. 2). I took into account the errors that may occur in the production process.

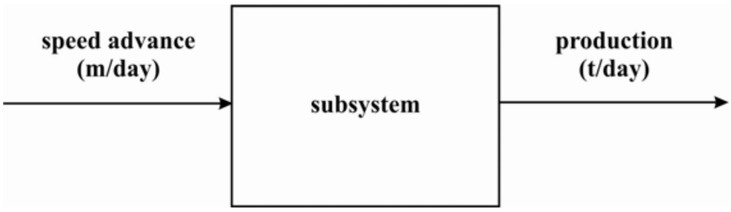

Fig. 2. The subsystem scheme "long wall mechanized – face"

After applying the method of least squares for ARX system, was obtained the mathematical model for the above subsystem:

$$A(q)\cdot y(t) = B(q)\cdot u(t) + C(t) \tag{1}$$

where

$$\begin{aligned} A(q) &= 1 - 0.6363\cdot q^{-1} + 0.251\cdot q^{-2} \\ B(y) &= 77.62\cdot q^{-5} + 206.9\cdot q^{-6} \end{aligned} \tag{2}$$

The ISI mathematical model is:

$$\begin{cases} x(k+1) = A\cdot x(k) + B\cdot y(k) \\ y(k) = C\cdot x(k) + D\cdot y(k) \end{cases} \tag{3}$$

$$X = \left(X_1\ X_2\ ...\ X_6\right)^T \tag{4}$$

That means:

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \\ x_3(k+1) \\ x_4(k+1) \\ x_5(k+1) \\ x_6(k+1) \end{bmatrix} = \begin{bmatrix} 0.6363 & 1 & 0 & 0 & 0 & 77.62 \\ -0.251 & 0 & 0 & 0 & 0 & 206.9 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} x_1(k) \\ x_2(k) \\ x_3(k) \\ x_4(k) \\ x_5(k) \\ x_6(k) \end{bmatrix} + \begin{bmatrix} 0 & 53.54 \\ 0 & -21.12 \\ 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} u \\ e \end{bmatrix} \tag{5}$$

$$y(k) = \begin{bmatrix}1 & 0 & 0 & 0 & 0 & 0\end{bmatrix} \cdot \left[X_1(k)\ X_2(k) X_3(k) X_4(k) X_5(k) X_6(k)\right]^T + \left[0\ \ 84{,}14\right]\left[u \quad e\right]^T$$

But:

$$\begin{cases} G(z) = C\left(z \cdot I_6 - A\right)^{-1} \cdot B + D \\ Y(z) = G_{11} \cdot U(z) + G_{12}(z) + E(z) \end{cases} \tag{6}$$

Finnaly:

$$y(z) = G(z) \cdot \begin{bmatrix} u(z) \\ E(z) \end{bmatrix} \quad \text{with} \quad G(z) = \left[G_{11}(z) \quad G_{12}(z)\right] \tag{7}$$

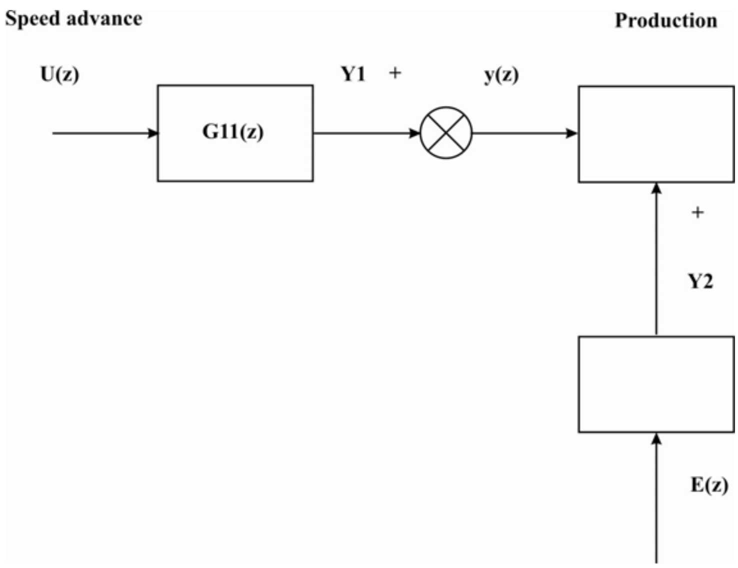

Fig. 3. Block scheme of the mathematical model

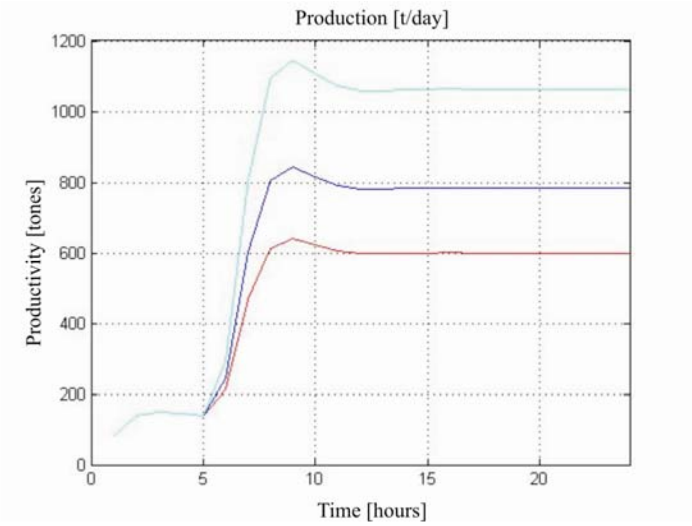

Fig. 4. Coal production in function of the front speed advance

Following the diagram can be observed that for a front speed advance of 1m/day can be obtained a production of 600 t/day, at 1.4 m / day a resulted a production of 785t/day and at a front speed advance of 2m/day could be obtained a production of 1063 tons / day.

3. CONCLUSIONS

An analysis of the long wall – mechanized face performance led us to conclude that each underground face working process is unique in terms of geological-mining conditions. Having the entrance conditions of extracting process, and whishing an increased production rate is necessary to take into account all the factors involved in the production process.

Thus it is necessary to introduce the concept of controlabillity which means the variation of the factors that characterize the size of entry in relation to decision-making factor, which can be kept under control in the following way: it can provide values that could be in various situations size for adaptive actions and you can freely change them upon certain size.

REFERENCES

[1]. **Covaci, Ş., Oncioiu, G.,** *Underground mines, vol.II*, “Corvin” Publishing House Deva, 1999

[2]. **Dumitrache, I.,** *Engineering automatic regulation*, Ed. Polytechnic, Bucharest 2005

[3]. **Iliaş, N., Andras, I., Gruneanțu, I.,** *News in roof support*, “Universitas” Publishing House, Petroşani, 2001

[4]. **Iliaş, N., Kovacs, I., Gruneanțu, I.,** *Mining machinery, being underground*, IMP

Lithography, Petroşani, 1989

[5]. Kovacs, I., Iliaş, N., *The work of mining shearers,* "Universitas" Publishing House, Petroşani 2000

[6]. Kovacs, I., *Study the work of the working shearers*, the thesis Ph.D., Petrosani, 1980

[7]. Marian, I., *Mechanization in mining*, Technical Publishing House, Bucharest 1969

[8]. Mândrescu, C., Automation of complex mechanized slaughter, "Universitas" Publishing House, Petroşani 2001

[9]. Onica, I., Chiril, G., *Top-coal caving method*, AGIR Publishing House, Bucharest 2005

[10]. Pleşea, V., *Stage technology and forecasts for the current operation sustainable in the Jiu Valley coal*, AGIR Bulletin no. 1/2007, January-March