THE SYSTEMIC ANALISYSIS OF THE INSTABILITY PHENOMENON OF THE MINING CONSTRUCTIONS IN THE COAL MINING EXPLOITATION JIU VALLEY- ROMANIA

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Abstract: The paper’s aim is to reduce the instability risk for the mining works, which could affect the underground mining constructions or the related surface areas. The subsystem of “rocks’ resistance” is analysed using the mechanical proprieties of rocks’mechanical resistance. These proprieties were observed and measured both “in situ” and in the laboratory. The effect of the rheological properties on the rupture phenomenon is also analysed using experimental data from few case studies.

Keywords: instability, mining works, rocks, mechanical proprieties, rheological properties.

1. INTRODUCTION

The Jiu Valley Basin is the largest coal basin in Romania, are carried out in 21 industrial units of CNH Petrosani. The Hard Coal National Company Petrosani, (CNH), carries out its activity in the hydrographic basin of the Jiu River along a length of 50 km and on an area of about 137 km^2.

The exploitation and the processing hard coal are carried out in 21 industrial units in this area. Mostly the mining of coal reserves in the Jiu Valley Basin is made in underground mines but there are some small open- pits in which are mined the outcropping reserves of some seams. Coal mining is carried out under ever-harder conditions due to the increased mining depth (1000m) and hazardous geo- mining conditions.

One of the difficult problems, the specialists encounter is in this field is ensuring the mine workings stability. The paper’s aim is to reduce the instability risk for the mining works, which could affect the underground mining constructions or the related surface areas.

2. THE SYSTEMIC ANALISYSIS

The study stages of the instability phenomena are rendered in figure 1 [3]. The assessment of the mining works' stability will be performed by taken into consideration the structural and physical characteristics of the rocks and the stress - strain state in the rock massif representing the input parameters.

Assessing the action of disturbing factors connected to the mining activity, as well as the action of the natural, hydrological and mechanical factors, the system's response is analysed by means of the phenomenon of rock's burst and falling.

The systemic approach of the problem concerning the stability of the mining works is leading to the assessment of the factors acting by means of the disturbing and causative parameters. This is achieved following the system response' analysis.

The stability phenomenon is analysed by means of the stability criteria recommended by the specific literature. In the table no. 1 the stability factors determine the following situations: stability state, limit state or instability state.

The instability of the mining works it is emphasized by means of: the tensile strength, the shearing strength and the state of tension-deformation of the mining work.

3. THE SUBSYSTEM OF THE EFFORTS AND DEFORMATION STATE

Within the framework of rock pressure study, it is particularly important to know the rock geomechanical characteristics. To this effect, all the features needed for establishing rock pressure behavior were determined under laboratory and “in situ” conditions.

The problem of determining rock pressure implies the following stages:

- ♦ Assessing the degree of mine pressure behavior;
- ♦ Determining rock displacements and the prevailing directions along which they occur;
- ♦ Determining rock pressure value;
- ♦ Establishing the dependence between the support shifts and the load borne by the support strain characteristic, respectively finding the real laws of rock- support interaction.

The experimental approach of measuring shifts and pressures can either confirm or not the analytical results and the laboratory ones can correct them in the context of underground conditions.

We order to assess rock pressure we made measurements by means of a dynamometric support which was set up at H = 820 m depth at the Petrila Mining Plant, located in gritty clay, measurements being made on the mine working contour.

The measurements were made in six-month period and the pressures ranged between 0.382 MPa and 2.39 MPa. A model of the pressure regime has been realized through an experimental identification [1], [4] and the pressure maximum value on the contour can be found and the comparative values of rock pressure are shown in table no. 2. The values of rock displacements on the contour from measurements are rendered in this table.

Table no. 2

Duration from the beginning of supporting [days]	Pressure P [MPa]		Rock's displace ments
	Calculated	Measured	U[mm]
1	0	0.382	1.9
2	0.396	0.489	4
5	0.598	0.59	10
6	0.735	0.89	16.2
7	0.883	0.97	16.3
8	1.033	1.01	20.2
9	1.179	1.12	25
12	1.575	1.734	49.3
16	1.979	1.859	50.8
20	2.29	2.01	52.8
23	2.32	2.19	60.3
27	2.35	2.359	66.2
30	2.368	2.36	68.1
34	2.38	2.379	68.1
40	2.397	2.39	68.1

In the subsystem of the Efforts and Deformation State some aspects related to the structural behavior of the rock massif, to the stress around the contour of the mining work and to the homogeneity and anisotropy are taken in account.

4. THE SUBSYSTEM OF ROCK RESISTANCE

The subsystem of Rocks’ resistance is analysed using the mechanical proprieties of rocks’mechanical resistance. These proprieties were observed and measured both “in situ” and in the laboratory.

At Petrila Mining Plant, rock samples have been determined and values of these properties are given in Table no.3.

The effect of the rheological properties on the rupture phenomenon is also analysed using experimental data from few case studies

5. THE STABILITY OF THE UNDERGROUND MINING CONSTRUCTIONS

In order to analyze the geomechanic conditions of the rocks in the Jiu Valley, some parameters evaluating the stability of the mining constructions have been considered.

The geomechanic conditions regarding the position of the underground mining constructions have been included in a general geomechanic classification; this classification has a practical value when choosing the interaction models and the prognosis of the mining pressure regime [2].

The geomechanic classification regarding the conditions the position of the mining constructions is shown in Table no.1

6. CONCLUSIONS

As a conclusion, the analysis regards the inputs, state and outputs parameters in the two subsystems also specifying the relationships among them. Based on the experimental results, the interaction between the subsystems and their effect on the underground construction stability is evaluated and presented.

The estimation of mining workings stability can be done by taking into consideration a series of geological, geomechanical and technical factors and by establishing correlation between them.

It is to be noticed that the rocks in the Jiu Valley belong to the category of difficult and very difficult mines from the viewpoint of rock stability.

Table no. 3

BREAKING STRENGTH TO		COHESION	INNER FRICTION ANGLE	ELASTICITY MODULE	POISSON COEFICIENT
compression σ_{RC} [MPa]	traction σ_r [Mpa]	C [MPa]	φ [grade]	$e.10^4$ [MPa]	μ
52	3.3	4.6	48	1.15	0.15
48	1.8	4	40	0.8	0.23
31	3	3	35	0.2	0.27

ROCK NAME	$[N/M^3]\gamma_{A.10}{}^4$WEIGHTVOLUMETRIC
Siliceous sandstone	2.58
Argillaceous sandstone	2.55
Sandy clay	2.52

Table no.1

ROCKS STABILITY	VERY STABLE	STABLE	MEDIUM STABILITY	UNSTABLE	VERY UNSTABLE
Strength of long time σ_{lld} [MPa]	> $0.9\sigma_{rc}$	$(0.85..0.89)\sigma_{rc}$	$(0.8…0.85)\sigma_{rc}$	$(0.75..0.8)\sigma_{rc}$	$(0.5..0.75)\sigma_{rc}$
Compressive Strength σ_{rc} [MPa]	> 200	100 – 200	50 – 100	25 – 100	< 25

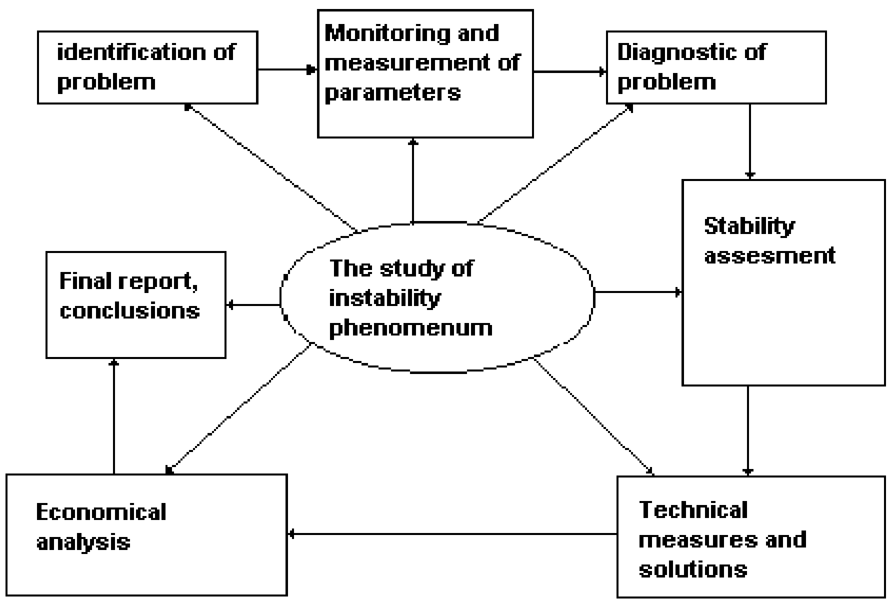

Figure 1. The study stages of the instability phenomenon

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