The 55th International October Conference on Mining and Metallurgy
15 - 17 October 2024, Kladovo, Serbia
https://ioc.irmbor.co.rs

DOI: 10.5937/IOC24167S Original Scientific Paper-Mining

CONSTRUCTION OF THE CEHOTINA RIVER BYPASS AND RELIEF IN THE WESTERN AND SOUTHWESTERN PARTS OF THE POTRLICA OPEN PIT WITH THE FUNCTION OF LANDSLIDE REHABILITATION AND CREATION SAFE COAL EXPLOITATION CONDITIONS IN 2024

Nikola Stanić[1a], Miljan Gomilanović[1b], Saša Stepanović[1c], Ivan Jelić[1d], Daniel Kržanović[1e], Dejan Bugarin[1f]

[1]Mining and Metallurgy Institute Bor, Alberta Ajnštajna 1, 19210 Bor, Serbia

[1a] nikola.stanic@irmbor.co.rs, https://orcid.org/0000-0002-6620-8563;
[1b] miljan.gomilanovic@irmbor.co.rs, https://orcid.org/0000-0002-1209-7423;
[1c] sasa.stepanovic@irmbor.co.rs, https://orcid.org/0000-0003-3485-201X;
[1d] ivan.jelic@irmbor.co.rs, https://orcid.org/0000-0003-4534-0706;
[1e] daniel.krzanovic@irmbor.co.rs, https://orcid.org/0000-0003-3841-8667;
[1f] dejan.bugarin@irmbor.co.rs, https://orcid.org/0000-0002-9103-4614

Abstract

Coal exploitation at the Potrlica open pit of the Pljevlja Coal Mine takes place in complex structural, geotechnical, and hydrogeological conditions. They are the cause of numerous restrictions regarding the mining works, the width of the excavation front, the speed of working front progress, the speed of deepening the mine and other aspects of exploitation on the one hand, and the deterioration of the safety of the work performance on the other hand. In order to continue the safe and reliable exploitation of this surface mine, it is planned to build a bypass of the river Ćehotina in the western and southwestern part of the open pit and to form stable slopes by additional excavation of masses in the zone of occurrence of engineering-geological processes that indicate possible instability of the masses. The implementation of the mentioned measures is planned in accordance with the results of the planned geodetic and hydrogeological monitoring

Keywords: *open pit, bajpas, stabilnost kosina, sanacija, monitoring*

1. INTRODUCTION

The Potrlica coal deposit (Figure 1) in the open pit zone is synclinal type with a steep slope of coal seams on the sides of the syncline. Such conditions in the deposit make the mining operations more complex, and especially affect the technology of excavation and disposal of overburden in open space of surface mining. In a narrowly limited area, there are fronts for coal exploitation, a plateau on which drainage facilities are located, and in the immediate periphery are internal overburden disposal sites - the old internal disposal site "Kipa 4" in the northern perimeter of the surface mine with the highest elevation on the plateau at 810 m and active internal landfill of Kutlovača in the eastern perimeter of the open pit with the final elevation on the plateau 825 m above sea level.

Exploitation of coal and burden is currently carried out according to the Supplementary Mining Project for the exploitation of coal at the "Potrlica - Pljevlja" open pit for the period 2020 - 2025.

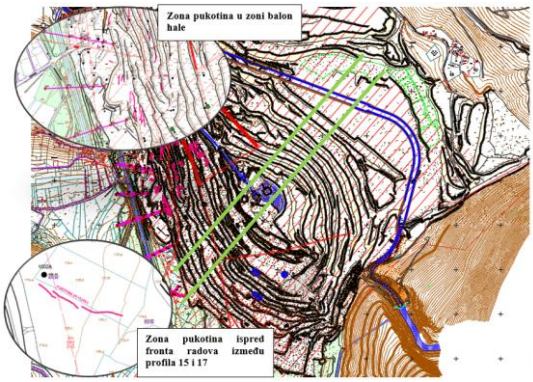

Figure 1. *State at the Potrlica surface mine, status as of January 1, 2024*

In 2023, the excavation of coal and overburden at PK Potrlica was carried out in the western and southwestern parts. In the western part of the work front, the designed state of the works was reached according to the valid project documentation, so the focus of operation was moved to the southwestern part of OP Potrlica. During the mining works in the western part of the surface mine between sections 15 and 17, instability is occurred. The instability manifested itself in the form of cracks and subsidence on the ground of the front of the mining works, about 40 meters from the Ćehotina river flow. Figure 2 shows the occurrences of instability in the Ćehotina riverbed zone. Signs of instability appeared in the form of cracks and ground subsidence.

a)  b) 

Figure 2. *Cracks (a) and material settlement (b)*

On the basis of slope stability analyzes in the zone of instability as a measure to rehabilitate the endangered zone and the possibility of securing sufficient quantities of coal, the Investor carried out a simplified mining project for the creation of a bypass of the Ćehotina river and relief in the western and southwestern part of the Potrlica open pit mine in the function of rehabilitating landslides and creating conditions for safe exploitation of coal in 2024. year.

2. CONSTRUCTION OF THE BYPASS OF THE RIVER ĆEHOTINA AND RELIEF OF THE MINE SLOPE

Construction and commissioning of the new bed of the Ćehotina river via the inner disposal is expected in 2025. Until then, mining operations must be carried out in safe conditions. At this moment, the appearance of instability, cracks and faults in the

immediate vicinity of the current river bed represent the greatest risk for exploitation. The case in which the sliding body would be activated and water from the Ćehotina river would enter the open pit would result with stopping work of open pit and large financial costs for the Electricity Industry of Montenegro [1].

For these reasons, a solution is envisaged in which the Ćehotina river is moved to the west of the working front. Limitations for defining the route were Ilino hill and the bridge near the hall for preventive maintenance. By analyzing several solutions, it was established that an option in which the local road is not moved is also possible, while at the same time meeting the conditions of stability and safety. Accordingly, a variant of the bypass was chosen, which starts from Ilino hill and ends at the place where the local road separates from the river bed. The length of the river bypass is about 1420 m and is shown in Figure 3.

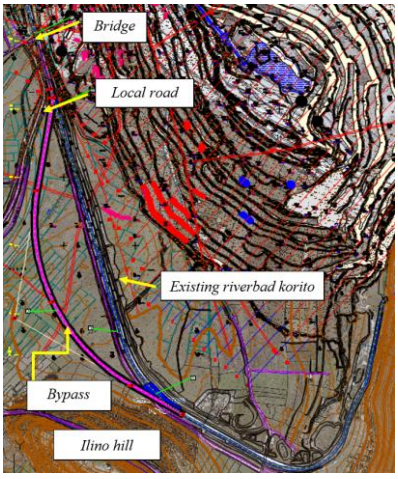

Figure 3. *Bypass of Ćehotina river [2]*

In addition to the construction of the bypass, relief of the slope between section 28 and section 5 at levels 745, 760 and 775 m where Quaternary and Neogene sediments will be excavated was also designed. The masses that will be excavated during the relief work amount to 2,779,789 m^3 or 5,309,372 tons. The position of the working front during relieving, the constructive parameters of the slopes and the volumes of the works were verified through the analysis of the stability of the newly formed slopes.

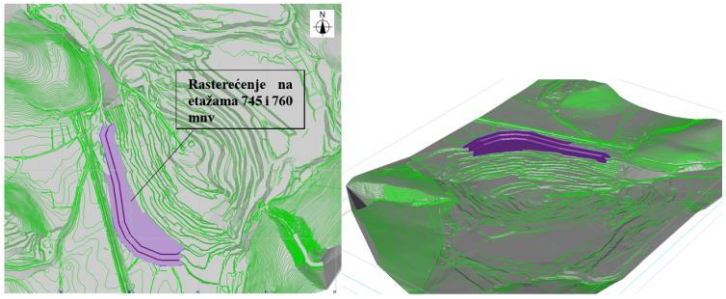

Figure 4. *Relief on benches on levels 745, 760 and 770 m [2]*

3. CONCLUSION

The stability analysis was performed on the 5 sections, for the case of the existing slope system of the working front and for the case when:

Bypass of the Ćehotina river is on the eastern part of the working front along the route shown in Figure 3.

The bed of the Ćehotina river is lined with a waterproof lining to prevent the infiltration of water from the river into the surrounding masses. Based on this, the degree of water presence in slope was adopted, which is characterized by a pore pressure value of $r_u = 0.1$.

Relieving of the top benches at levels 770, 760 and 745 m in order to ensure stable slopes of the working front towards the route of the river, i.e. the bypass where it is being built.

The calculated safety factors are shown for the specified states in Table 1.

Table 1. *Calculated safety factors of the slope system at the working front [2]*

Section	Slopes system on working front, status 1.11.2023. (pore pressure ratio r_u=0.2)	Slopes system on working front with reliefing (pore pressure ratio r_u=0.1)
Section 1	2.352	3.315
Section 2	1.898	3.194
Section 3	1.124	2.077
Section 4	1.115	1.467
Section 5	1.100	1.316

Based on the performed stability calculations, can be concluded that the construction of the watertight bypass of the Ćehotina river prevents the inflow of water from the river bed and thus increases the safety factor of the general slope of the open pit Potrlica.

Another significant factor that affects the increase of the safety factor is the loosening of masses in the volume of about 2,700,000 m^3 in the zone between sections 5 and 28. In this way, the angle of the general slope is reduced, that is, the stability of the formed general slope is increased.

It is planned to carry out monitoring of slope stability and the state of the terrain in front of the working front, as well as hydrogeological monitoring in the considered zone. The construction of a bypass and excavation in order to relieve the pit slope would be carried out in accordance with the results of the monitoring in a situation where it indicates the inadmissibility of deformation and movement of masses, i.e. significant changes in the level of groundwater that would indicate their possible penetration into the open pit.

ACKNOWLEDGEMENTS

This work was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, contract no. 451-03-66/2024-03/ 200052.

REFERENCES

[1] A. Doderović, N. Stanić, M. Gomilanović, S. Stepanović; Mining and Metallurgy Engineering Bor, 1 (2023) 17-26.

[2] Simplified mining project for the construction of a bypass of the Ćehotina river and relief in the western and southwestern part of the Potrlica surface mine in the function of rehabilitating landslides and creating conditions for safe coal exploitation in 2024.