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Professional paper

JUSTIFICATION OF COAL EXPLOITATION FROM THE "CERJE – JOVAČKO POLJE" DEPOSIT

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Abstract: In this paper, the problem of the one of the deposits in PE - PEU "Cerje - Jovačko Polje", located in the Despotovac basin, currently not in production phase, was solved. Deposit was opened with two parallel inclines and exploring mining operations are not finished. Within this deposit, certified balance reserves are 6,156,970 t.

Key words: coal, coal zone, Despotovac, Cerje-Jovacko Polje

1. INTRODUCTION

The basic idea, followed by the authors of this paper, based on the existing research results and the current level of evaluating of the "Cerje - Jovačko Polje" coal deposit, situated in the Despotovac coal basin, is to evaluate the energetic potentiality and possibility to activate this deposit as replacement facility by the time the mine "Rembas" finds more adequate solutions.

For the analysis of the possibilities of coal exploitation from this deposit, both technical documentation available to the authors was used, and relevant experts who have also studied this issue were consulted.

The research results obtained in the framework of this paper clearly indicate that, followed by the geological characteristics, under certain techno-economic conditions, there is possibility of commercial exploitation of this deposit.

2. FIELD CHARACTERISTICS

Despotovac coal basin is located within the Velika Morava neogene field, and it makes the continuation of the southern Mlavska Petrovac neogene basin filled with lacustrine formations.

The basin is limited to the older sediments - by the Permian red sandstone term, Triassic sediments and crystalline schists on the north, the Triassic, Jurassic and ower cretaceous limestones on the east, and by the Paleozoic crystalline schists on the west.

"Cerje - Jovačko Polje" deposit is located in the northern part of the wider area of the city Despotovac and, administratively, it belongs to the Despotovac municipality.

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The treated deposit is situated between early exploitated areas - the Zeleni Lug in the north and mine "Sreća" in the south. In addition, there was coal exploitation released in the northern part of this deposit for many years - in the Bočinac, Venac and Zabela minefields. These coal layers – seams were Sarmatian age (Nikolić and Dimitrijević 1990; Simić et al. 2009).

3. MINING AND GEOLOGICAL DEPOSIT CHARACTERISTICS

Analyzing data from explorations realized so far, as well as lithological composition, structural materials and distribution of certain coal layers in the "Cerje - Jovačko Polje" deposit in the Sarmatian series, a several coal layers were indicated, of which four have exploitative thickness, distributed in two coal horizons: the lower horizon represented by layers B_1 and B_2 and top horizon is represented by layers A_1 and A_2.

The distribution of these layers is different and those occupy areas of different size, and those are located at different in-between distances.

Horizon with layers B_1 and B_2 has the widest distribution in the so far explored area, with tendency of further development to the west and northwest direction, and future researches should be directed in those courses. Layers are regular in the whole area with constant thickness, locally separated by dirt bands made of coal and gray clay, so that the thickness of clean coal layer varies from 1.0 to 3.0 m, while including the dirt bands it is up to 6.0 m.

The occurrence of depths of these layers are different - the lowest, in the eastern parts, where in depth of 15.0 to 20.0 m, while going to the west and northwest, dippings are lower and, finally, layers reach depths over 100.0 m, so that some drill holes rest shallow and fallow, because they, at last, did not reach the whole coal series with of B_1 and B_2 layers.

Layers are dipping slightly at an angle of 10°- 20°, from the east to the west and those are occasionally intermittent with faults, so they might have block structure look.

The floor of the B_2 layer consists of gray marl and sandy clay with some thin intercalations of coal, crossing gradually into the tortonian layers, also with several coal layers. Between layers B_2 and B_1 gray marl and sandy clay are located, and also clayed sands in some places. The range of thickness of these intermediate layers is from 15.0 to 20.0 m. Following unexpected conditions, those send clays show tendency for swelling, which will, certainly, reflect to the stability of the parts of the underground rooms. A special problem can occur in clay sands in the roof sediments, because they are usually carriers of underground water, which can cause fall of underground room and penetration of liquid sand into the rooms.

Horizon which includes layers A_1 and A_2, covers mostly the west parts of the deposit, while in the north-eastern and eastern parts, it is eroded, due to the shallow depth of occurrence, so in some places the parts of horizon were preserved in the form of a erosion patches.

Layers have a complex structure, and those, more or less, are spelled by dirt bands of black or gray clay or coaly sandy clays with thickness of 1.0 - 3.0 m, by the

clean coal with layer thickness from 1.0 to 2.3 m. The depth of these layers is different, ranging from 10.0 m to in eastern part, 75.0 m to the western part of deposit, which indicates a slight dipping of the coal series to the west.

Floor of the coal layer A_2 mainly consists of coaly clays, gray and sand clays, with thickness of about ten meters. These sediments consist of direct overlaying coal layer B_1. Above this layer, there is, partially, the A_2, with thickness of about 1.0 m, limited to a small area in the western and northwestern part of the deposit in the form of erosion patches. In the eastern parts of deposits, both layers were affected by erosion, so that the distribution is significantly less, compared to the layers B_1 and B_2.

In a direct and overlaying roof of these layers, the gray fat clay and sand, and in some places, clayed sand, occur. Everywhere, about ten meters from the surface, appears gravel thicknesses from 3.0 to 5.0 m, covered by humus cover.

Analyzing layer conditions and lithological composition of Sarmatian coal-bearing series, it can be concluded that due to the wide-spreading and economic value, the most significant layers are B_2 and B_1, while A_1 and A_2 layers are considerably less spread and have less economic importance.

Mining and geological field researching, based on the determined indicators, show that in this layer, the block structure and splitting of the layers along the main fault lines is expressed, but those should not cause increase of cracking rock masses, because of the accompanying rock lithology.

The complexity of coal layers indicating heterogeneity, and layering lines between the layers of overburden and coal at the same time present the lines of discontinuity and predict possible slip directions during the realization of mining operations. However, convenient decline of coal layers of 10°- 20° greatly reduces this negative characteristic of the working environment.

Physical and mechanical characteristics of rock masses indicate favorable performances for drilling and blasting in the coal layer and less resistance for digging works. Low compressive strength of the examined samples of coal and associated rocks indicate low bearing of the working environment, but the relatively shallow depth of the coal layers, indicate the better working conditions.

Increased underground pressures should be expected when mining works are realized through the fault zones, with the possibility of penetration of liquid sand and water. The possibility of clays and clay material swelling in the mining rooms with the high humidity leads to increasing pressures and reducing of cross section the underground rooms. However, considering the shallow depth of coal seams, the physical-mechanical properties of rock masses, a favorable angle of layers and previous experiences working in this environment in terms of mining and geological conditions, this working environment could be considered as favorable for the underground mining.

The preference of coal combustion was not performed in any of the mentioned pits, but from our experience we can say that Despotovac coal is not prone to spontaneous combustion. Relatively small thickness of coal seams, chemical composition, moisture content, a lot of other technical requirements in the process of excavation, exclude the possibility of creating heat and undergoround pit fires (Vidanović et al. 2011).

3.1. Coal reserves

Determining of coal-bearings and reserves calculation in the deposit "Cerje - Jovačko Polje" was performed on the data obtained from exploration drill holes in previous years, and the latest data from holes drilled in the period 1986/88. year, which are not covered by the prior elaboration. Based on all the data and the current level of exploration, level of research work, as well as detailed analysis of the structural-tectonic relations and the layer characteristics, the coal-bearing area was boundared.

According to tectonic disturbance and structural complexity, this part of the deposit is divided into seven geological blocks, each limited by faults. Due to the variability and complexity of this layer, deposit is classified in the first group is characterized as a simple material with gently sloping layers up to 20°. According to variability of layers due to thickness and prevalence layer is classified in subgroup III, but without losing layer thickness of 1.0 m, which is taken as the lower limit in the calculation of reserves.

Deposit boundaries determined by the exploration boreholes allowed exploitation the reserves of categories B, C_1, and up the lane of layer thickness of 1.0 m.

The eastern border is determined on the basis of data from borehole that are not detect coal layer and the eastern boundary is part of the outcrop, and depending on the spreading, determined by the different layers. Northern and western borders, is not definitely determinated, because the spreading of the coal-bearing series is expected in these directions, in the direction of former mining fields "Bočinac" and "Zeleni Lug" and expanding this of field will be in that direction. Southern border is also drawn to the database from the exploration drill holes, by which only development of the Tortonian older coal-bearing series has been proven. Within this deposit several faults was detected, on which the current deposit is divided into 7 blocks. According to the present level of exploration, density and distribution of research works, coal reserves are classified as B and C category. Reserves for category B distance between exploratory boreholes were within acceptable limits for this group of deposits.

THE COAL LAYERS B_1 AND B_2

These two layers cover the largest area consisting mostly of the largest coal reserves. Previous explorations have shown that coal seam B_2 regularly distributes throughout the explorated area, with average thickness of 4.4 m of clean coal, and with much more including dirt bands. Due to the small depth, some boreholes did not detect this coal layer, and in these areas, it should be expected to appear in the greater depths than depths achieved up to now.

Separate area of this layer covers an area 3,183,325 m^2 with established reserves of 5,308,310 t of coal B and C_1 categories. Hypsometrically observed, in the eastern part of the layer, there is an level of +155.0 m and slightly descends to the west up to the level of +56.0 m.

B_1 layer have almost the same as the distribution of layer B_2 and covers an area of about 5,071,900 m^2 with the calculated coal reserves of 4,590,430 t of B and C_1 categories. There is a regular development of the entire area with the layer thickness of

1.0 - 4.9 m of clean coal. In some places there are stratified dirt bands so it goes to total thickness of up to 6.0 m. Hypsometrically, it is located about 20 m above the layer B_2, in the eastern part of the elevation of the level of +170.0 m, while in the western and northern part descends to the level of elevation of +112.0 m, and a southwest to the level -15.0 m.

Taking into consideration both economic and technical aspect, the horizont with these layers is of special importance, and future exploitation is based on them.

THE COAL LAYERS A_1 AND A_2

In the higher parts of Sarmatian series, there is an excluded horizon consisting of A_1 and A_2 layers, developed in a much smaller space, or preserved in the form of a patch of erosion. The eastern and northern part of the excavated area of the two layers is eroded so that in this isolated part there are two small areas, which have preserved these layers.

In the southwestern part of the coal layer, there is a slightly larger distribution, with the exploitation thickness of 1.0 - 3.0 m of clean coal. It is located at 10 - 20 m above the layer B, and in the technical sense, it can be economically interesting. This layer is separated into blocks I, II and III in area of 724,250 m^2 with the reserves of 1,152,020 t of B category. Hypsometrically, it is located on the highest elevation, about +150.0 m and the lowest, about +10.0 m.

A layer of coal, spread in the western part, of substantially less thickness of 1.0 - 2.7 m, and in the north it is limited to a small area with a thickness of 1.35 m. It is located at the elevation of +160.0 m, to the elevation of +140.0 m, and at 20 - 40 m above the previous layer.

The deposit is opened with two parallel exploring inclines down to +150.0 m level, interconnected with an exploration drift (Figure 1), at the level of layer B_1, but, in our opinion, due to the small amount of opening rooms, these reserves could not be classified in the A category.

Coal reserves in this deposit are classified in the balance and off-balance sheet reserves. Coal reserves were selected in the deposit area, where there are no technical possibilities to their profitable exploitation, taking into consideration the lower limit of 1.0 m thickness. Balance reserves were selected in the security pillar formated for asphalt road and railway Svilajnac-Despotovac. In addition, off-balance reserves are isolated in the areas within the blocks, where the boreholes showed slightly less than 1.0 m thickness of clean coal layer. It is believed that, while drilling, there is a determination of smaller thickness because of the wash out the core from the drill hole, or that the layer is presented by coaly clays only, and in those parts only pure coal mass is taken into consideration.

Total coal reserves, treated according to the previously mentioned criteria, in the layer "Cerje" are about 6,156,970 t (Simić et al. 2009; Vidanović et al. 2011).

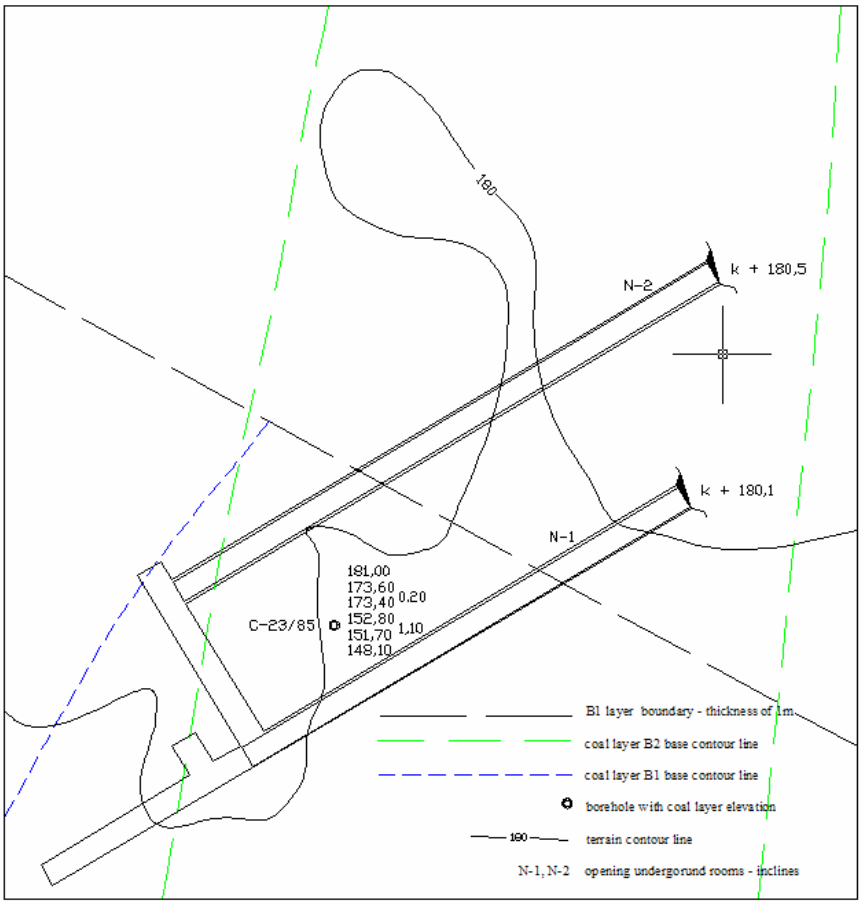

Figure 1 - Opening undergorund rooms - inclines N-1 and N-2

4. CONCLUSION

On the basis of techno-economic analyses of geological and conditions of "Cerje - Jovačko Polje" deposit, significant reserves were found, which amount to 6,156,970 t of relatively high-quality coal, but the situation in layers is such that it leads to serious doubts about the justification of its opening as a separate production unit. Taking into consideration the fact that coal is a strategic raw material that participates in the power balance of Serbia with over 50%, the solution for exploitation of this important resource must be found.

Current estimations are that mine "Cerje - Jovačko Polje" can not achieve the capacity that would be rated as significant in terms of overall production increase in Resavska-Despotovac coal-bearing zone, but rather as a replacement facilities, which substitute some of the production of the excavated mine "Rembas".

All this points to the need for a conceptual approach to the problem more comprehensively. According to the author, the solution should be sought in the

simultaneous opening of the mines on several possible locations, or some of them, which are in the close proximity ("Cerje - Jovačko Polje", "Zeleni Lug", "Bočinac", "Venac" and "Zabela"), which would enable organization of the mine work with serious production (more than 500,000 tons/year of coal). To check these assumptions, it would be necessary to do an integrated feasibility study, which would observe these deposits as a single unit, and that would have a common strategy and logistics.

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