



THE SIGNIFICANCE OF SMALL COAL DEPOSITS IN THE ENERGY CRISIS "BUKOVA KOSA" FIELD, PRIJEDOR

Review
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Abstract: *In the time of crisis caused by the current geopolitical situation, it is confirmed that fossil fuels represent the strategic potential of every country. Many countries in the world, as is known, in order to reduce CO₂ emissions, have based the production of electricity on the use of renewable energy sources, such as solar energy; wind energy and biomass. However, due to economic reasons such as required large investments, and also due to the already existing thermal power capacities and the existing raw material base, coal still plays a dominant role in the Balkan countries. In the process of transition to renewable sources, the need for continuous supply of this mineral raw material is more than obvious, and it is surely getting close to its peak use. First of all, for financial reasons, but also as a function of time, we need resources that can be reached as cheaply and quickly as possible.*

Key words: SMALL COAL DEPOSITS, GEOLOGICAL EXPLORATION, RESERVES, ECONOMIC EFFECTS.

INTRODUCTION

Large ore deposits, first of all, require significant financial resources, but also a long period of time from the first prospecting works through the exploration process and valorization of resources and reserves to the finalization - the beginning of operation. Namely, "Coal from the western part of the Kostolac coal basin" was discovered in the period between the two world wars, when the first exploratory boreholes were drilled, so that the first Certificate of Reserves was issued on December 10, 2015, and the development of the Main Mining Project is still in progress. It almost takes a whole century from the first prospecting to the first excavated ton.

That is why we will give an example today of a small but in all other respects significant brown coal deposit - "Bukova kosa" near Prijedor, the Republic of Srpska (B&H).

This deposit, at the foot of Kozara, was already known in the period between the two world wars, but due to other deposits, which are larger in terms of surface area and reserves, it remained out of the focus of both the professional public and business entities.

Due to the newly created situation, and the increased needs in both the electric power and thermal power sectors, this deposit has been placed in the focus of interest.

In accordance with the current legislation, in a short period of time from October 2023 until April 2024, geological surveys were carried out and reserves were verified.

Key terms:

- October 2023 - Finalization of the detailed geological exploration project;
- November 17, 2023. - By the decision of the Ministry of Energy and Mining of the Republic of Srpska, the performance of detailed geological exploration of coal at the "Bukova kosa" site was approved;
- November 2023 - January 2024. - Carrying out detailed geological exploration works with laboratory works;
- April 23, 2024. - Study on classification, categorization and calculation of brown coal reserves at the "Bukova kosa" deposit near Prijedor - verified by the Commission for revision of the Study on classification, categorization and calculation of reserves of mineral raw materials of the Republic of Srpska, and REVISION CLAUSE issued

BASIC DATA ON COAL DEPOSIT "BUKOVA KOSA", PRIJEDOR

The area "Bukova kosa" is located about 6 km of air space, northwest of Prijedor. The regional road Prijedor - Kozarska Dubica runs along the immediate border of the "Bukova kosa - Prijedor" coal deposit, and the transport conditions are therefore very favourable.

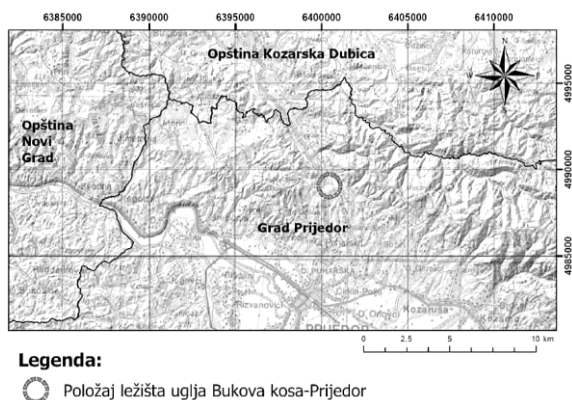


Figure 1, Geographical location of the brown coal deposit "Bukova Kosa" near Prijedor

The deposit "Bukova kosa" covers an area of 333.827 m² or about 33,38 ha. It is located in the area between Veliko Palančište and Gornji Jelovac. It belongs to a hilly-rolling and slightly corrugated terrain with no distinct height differences. It stretches between 254 and 327 metres above sea level. It has a moderate continental climate with the influence of the Pannonian belt, humid type climate.

The underground and surface waters of the deposits drain from the western side of the Puharska River into the Una River, and from the south the Obarak stream into the Sana River.

The morphological characteristics of the terrain provide very favourable conditions for surface operation, which can be carried out in the period from the beginning of February to mid-December.

GEOLOGICAL STRUCTURE OF THE DEPOSIT

The productive Mycenaean deposits in which this deposit is located occupy an area of about 3 km², of which only a small part of 33,38 ha was covered by detailed geological exploration.

The productive series is of Miocene age and consists of:

The floor zone of the deepest parts of the basin is made up of gray, gray-green, green and marly clays. It is defined by exploratory drilling on the entire deposit, and as a rule, boreholes are suspended in it.

The coal zone consists of coal, carbonized clays, marly clays and marls. It starts with dark gray, almost black clays, rarely carbonaceous. Then comes the coal seam itself, built of black and brown coal, seamed with black coal clay, rarely dark gray marly-coal clay. Established by exploration boreholes and exploration-operation levels, the thickness of the coal seam varies in the interval of 0,80–12,10 m, average 7,76 m.

The roof zone consists of marl, marly clay, clay and less frequently sandy clay and sand. Its thickness is variable and ranges up to a maximum of 20,20 m.

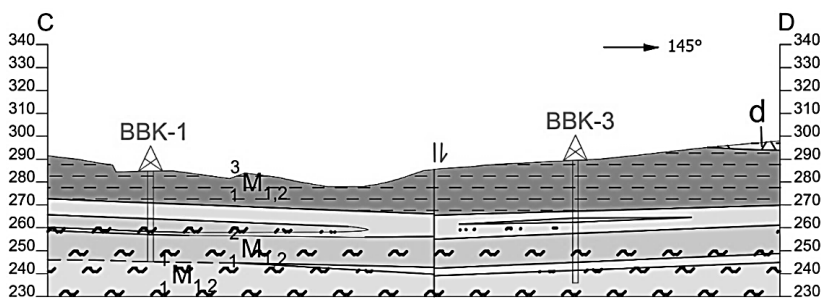


Figure 2, Characteristic geological profile of the deposit "Bukova Kosa"

Coal was created by settling of plant material - of autochthon Limnica origin. The coal deposits of the "Bukova kosa-Prijedor" deposit are part of the productive deposits of the Palančiše lake basin.

Therefore, the main mass of coal reserves is contained in one ore body - one seam, within which dirt bands occur. This ore body remained largely uncontoured in the direction of the southwest, south and east, due to the property legal relations of the parcels. In general, the coal seam in the eastern part of the deposit dips slightly to the west, while in the western part of the deposit it dips slightly to the northeast, with the same dip angles of about 5°.

It is assumed that the "Bukova kosa" deposit contains normal faults, but the faults could not be directly observed due to the almost complete coverage of the terrain by deluvial and proluvial sediments.

Certain minor microcracks and numerous cracks were observed on the open profiles of the exploration and operation levels. Exploration has established that there is no potential possibility of underground water accumulation that would threaten the excavation of coal.

DISPLAY OF EXPLORATION RESULTS

Detailed geological exploration works on this deposit were carried out using standard proven methods:

As part of the geological works, a detailed geological mapping of the terrain and the creation of a geological map of the deposits, geological mapping and testing of the core of exploration boreholes and exploration- operation stages were carried out.

Drilling and processing of 8 exploratory boreholes was performed according to the Rulebook, for the 2nd group - 2nd subgroup of coal deposits at adequate distances in a volume of 319,70 m. The depth of the boreholes ranged from 20,00 m to 54,00 m and all gave positive results.

Two exploration-operation stages were carried out in order to establish outcrop zones and take samples.

Based on laboratory tests, the coal from the "Bukova-Kosa-Prijedor" deposit is humic coal with a high content of huminite, relatively low content of liptinite, variable content of inertinite and mineral substances. According to the degree of chemical maturity, the examined samples belong to **matte hard brown coals**. Petrographic tests were performed at the Faculty of Mining and Geology of the University of Belgrade. The coal quality was analyzed through weighted mean values and it proved to be satisfactory.

Table 1, Qualitative characteristics of "Bukova Kosa" coal

Parameter	Average value
Total moisture	26,14 %
Ash	32,16 %
Sulphur - combustible	6,89 %
Sulphur – binding	1,08 %
Volatile matter.	25,15 %
Combustible matter.	41,99 %

Parameter	Average value
C - fix	16,56 %
Coke	48,71 %
Bulk density	1,34 t/m ³
GTV	10.683 kJ/kg
DTV	9.652 kJ/kg

COAL RESERVES

On the basis of morphological, structural and genetic characteristics, the deposit is classified into the second group - the second subgroup of coal deposits, and the balance reserves of coal include masses of coal seam whose thickness exceeds 0,80 m, and interlayer dirt bands with a maximum thickness of 10 cm are included there.

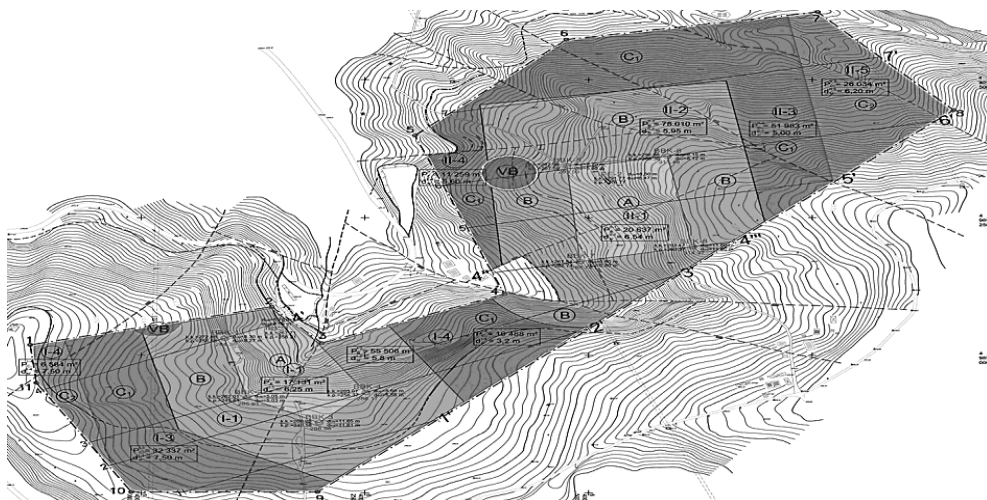


Figure 3, Map of reserves of brown coal deposit "Bukova Kosa" near Prijedor

After producing the reserves map, the reserves were calculated using the methods of vertical profiles and calculation blocks and their balance and exploitability were determined with operation losses of 5%.

Table 2, Overview of "Bukova kosa" coal reserves, near Prijedor

Reserves (t) Category	Balance	Operational	Potential	Total Geological
A	313.241	297.579		313.241
B	1.138.843	1.081.901		1.138.843
C ₁	742.091	704.986		742.091
C ₂	-	-	307.900	307.900
Total:	2.194.175	2.084.466	307.900	2.502.075

TERMS OF OPERATION

On the deposit "Bukova kosa" whose area is 283.338 m², the following was determined:

- Balance reserves of coal = 2.194.175 t;
- Operational reserves of coal = 2.084.466 t;
- Potential coal reserves = 307.900 t;
- The quality of the mineral raw material meets the quality requirements for use in thermal energy;

- Concentration of balance reserves A, B and C1 category = 7,74 t/m²;
- Projected operational losses = 5%;
- Annual production capacity = 400.000 t and
- Operational life = 5,2 years.

Surface mining of coal is planned, with the use of excavators, loaders and transport trucks on floors 10 metres high.

The operation technology at the surface mine will be carried out from top to bottom, according to the following stages:

- 1) Preparatory work
- 2) Uncovering and moving the waste cover (**overburden**);
- 3) Excavation and loading of coal - with an excavator;
- 4) Transportation of coal to the primary depot - by trucks (capacity up to 25 tons);
- 5) Transport and backfilling with a humus cover for the purpose of recultivation.

The specificity of operation by using the exposed method lies in the impossibility of working in winter conditions. In terms of other elements essential for operation, there are no special problems, provided that the norms of the surface operation system are applied.

The following basic parameters were adopted by the method of analogy:

- Bench height 10 m,
- Width of transport communications 12 m,
- Width required for loading 10 m,
- Angle of inclination of the floor 45,
- Final contour angle 25.

There is no underground water on the deposit that could threaten operation. Drainage of floors, in times of heavy rainfall, will consist of the orderly management and maintenance of the floor level under a gentle slope of 1-2% in the direction of gravitational drainage of water.

Looking comprehensively at the factors important for the coal excavation, it may be concluded that the conditions are favourable for excavation.

FINANCIAL ANALYSIS

Precise records have established that the total funds invested in coal exploration on this deposit amount to: KM 191.580,00 or € 97.456,75. Considering the international character of this symposium, we will continue to show all monetary values only in euros for easier monitoring.

According to the analysis of market data, the average price of coal is 76,31 €/t.

Coal production costs amount to 48,33 €/t.

The profit for this deposit amounts to: $R = \text{€/t } 27,98$, i.e. $R_g = \text{€/year } 11.191.400,00$.

The economic evaluation of the deposits without taking the time factor into account established that the value of "Bukova kosa" coal is €58.320.232,00.

With the economic assessment of the deposit, taking the time factor NPV of the deposit with 2025 as the "0" year, amounts to: €46.656.947,00.

The encumbrance with exploration costs is only €0,046 per 1 t of balance reserves.

Each €1 invested in geological exploration provided an increase in coal balance reserves by 22,45 t, which represents a very high increase per unit of investment.

Based on the ratio of the value of the deposit and the total exploration costs, it was established that one euro invested in exploration provides an accumulation of €154,86

Immediately, the ratio of profit per unit of reserves indicates a profit of €16,41/t of extracted coal.

From the ratio of exploration costs (€/t 0,046) and profit (€/t 16,41), the coefficient of economic effectiveness was obtained in the amount of 0,28%.

Therefore, the share of exploration costs for 1 ton of raw material is 0,28% of the accumulative value of that same ton. This indicates that insignificant financial resources were spent on exploration, so we can say that it is a matter of high effectiveness of exploration.

Based on the presented results, it is concluded that under the given operational and market conditions, the coal reserves in this deposit have a significant economic value.

CONCLUSION

Based on the factual data presented in the paper, it can be concluded that the time required for detailed geological exploration in addition to the raw material base is of crucial importance in making a decision to start the entire project, given that in addition to the positive financial effects, the most important one, namely, the beginning of excavation of mineral raw materials, will be realized which, justifies all that. That is why small deposits are of great importance, because in addition to significantly smaller investments, they ensure fast and stable, economically cost-effective production.

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