SOME ISSUES OF THE MINING PART OF THE PROBLEMS OF LAND-RECLAMATION OF WASTE DUMPS OF THE KOLUBARA OPEN PIT MINES, SERBIA

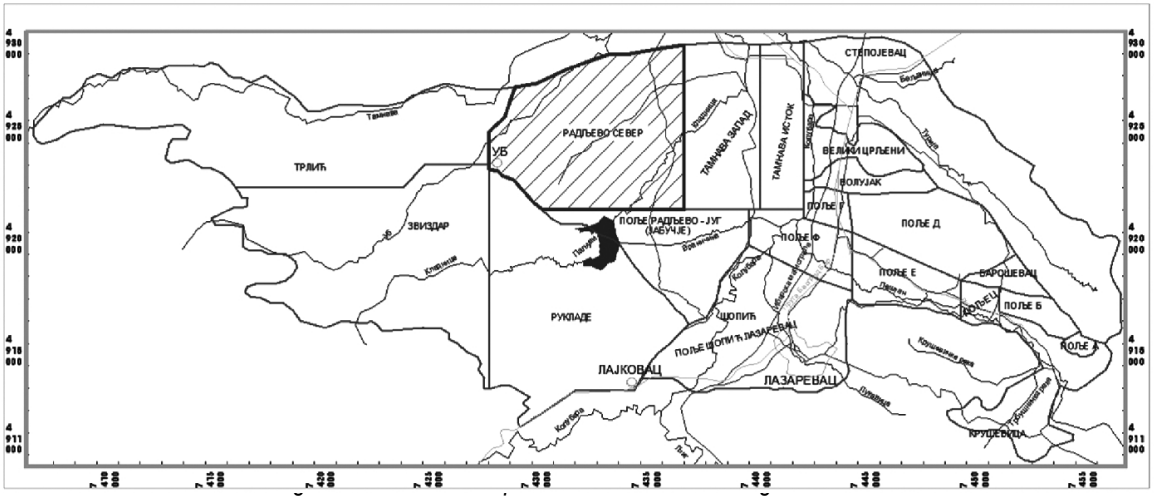
Sasa Ilic, min. eng.
University of Belgrade, Faculty of Mining and Geology, 7 Djusina st., Belgrade, Serbia,
sasa.ilic@rgf.bg.ac.rs

ABSTRACT
The targeted aim of this paper represents the analysis of manners and estimation of viability of the selected mining and dumping of overburden in function of revitalization and land-reclamation of the degraded space at coal open pit mines in PE Kolubara of the Electric Power Industry of Serbia (EPIS).
Key words: *lignite, selective mining and dumping, land-reclamation.*

1. INTRODUCTION

The making of this paper is in accordance with the endeavours of EPIS to entirely treat the overall problem and to undertake its continuous solution consistently with the standards prevailing in these fields within highly developed countries.
The objectives are:

a. Studying of the existing status and present experience covering the land-reclamation of the spaces exposed to coal surface exploitation within this country and worldwide;
b. The analysis of the existing technological solutions on coal open pit mines within the system of EPIS for the purpose of understanding the possible modifications with the aim to find out the selective excavations and dumping of overburden, as well as studying the alternative new separate solutions;
c. The analyses and estimation of possible processes covering the land-reclamation of the degraded surfaces, in variants with or without selective mining and dumping of overburden;
d. The proposal for solving the organization of performance of the technical services and biological land-reclamation;



The initial reasons for preparing of this paper are numerous, one of them representing the legal regulations. It imposes the obligation of observing the provisions which, directly of indirectly, refer to the

problems of land-reclamation, revitalization and spatial arrangement of the degraded surfaces, which also establish a series of requirements for preventing the appearance of permanent damages and affects on the living environment. To this effect, the recommendations contained in this report, are in accordance with:

- Law on mining (the Official Gazette of the Republic of Serbia prescribing elaboration of the project on land-reclamation of the degraded land.
- Law on agricultural soil. Particularly the Article 24 requires existence of reclamation project with the specific review on the procedure of removal and preservation of the humus layer, the applied technical and biological measures, as well as the terms of carrying out individual phases.
- Law on bases of living environment protection; Law on facilities building construction ; Law on waters; Handbook on analysis on effects of facilities, namely effects of works on human environment; Law on geological research and Law on planning and development of space and settlements.

The legal regulations explicitly prescribe the need for land-reclamation as the procedure of turning back to the original natural functions and production capabilities to the destroyed land. This law order is essentially supported by:

1. Moral and civil reasons, obligations and respect towards the human being and its posterity;
2. Ethic reasons, namely the land represents the renewable natural wealth and must not be permanently degraded or destroyed, but preserved;
3. Economic-social reasons, land-reclamation and restored surfaces, after regaining the natural function and production capability, represent a new source of existence, might be assigned, changed or alienated with financial indemnity, being of the specific significance for the EPIS.

Land-reclamation, from the general point of view, covers the renewed establishment of plant communities (vegetation) over the surfaces remaining after coal exploitation. Land-reclamation may be carried out periodically (discontinuously) or continually through following the mining activities. Under EPIS conditions it has discontinuously been carried out.

The selected method of land post-utilization must fulfil the requirements of local inhabitants, the needs of natural environments, the properties of the newly-formed land, post-exploitation stratigraphy and costs, namely the cost price. To achieve all the above mentioned, the following should clearly be defined:

- Preservation strategy, either of integration or of partial type? Partial preservation strategy prevails worldwide, resulting in estimates of priority areas for preservation of species and natural environments.
- Within the areas where the restoration for protection of nature would be carried out, the main targets should clearly be defined, whether being either preservation of the natural process or preservation of species (biodiversity).
- As concerns the areas not classified into the priority category, the solutions of co-existence of land recovery and its preservation should be found out.

Apart from the regulations, the important factor for a successful land-reclamation represents both the ownership and the way of financing. Expropriation of land (predominantly of the agricultural soil in the (Kolubara basin) purchased from the farmers should be reclaimed for agricultural purposes and change with farmers on the occasion of new expropriations for further development of open pit mines. The social lands, the lands in the vicinity of settlements, should be used, apart from agricultural purposes, for forests, parks, recreation complexes, animals and plants environments, for industrial capacities, residential building, sports fields and similar.

The owner of the entire degraded land is EPIS. For the two main reasons, financing of the works of reclamation, should be partially carried out from the public sources, as well. The primary reason being that the national feasibility, namely general well-being, is that over almost 9,000 hectares (so far) of degraded land by the surface exploitation, natural and economic-production functions be returned. The second one being of a moral attitude, representing the deserved reduction of the EPIS costs for rehabilitation of the exploited space, as the EPIS over decades allocated and is allocating large funds to the state budget on the account of legal obligations “on payment of indemnity for changes of the purpose of agricultural soil utilization.

Establishing of a good vegetation cover is conditioned by chemical properties of the soil, by texture, structure and compactness, by the medium for sprouting and growing of plants, good approach to the water

and drainage. Providing a favourable environment for the root system represents a key point of a successful reclamation. The layer of a natural fertile land over the surface (solum), renders wider possibilities for reclamation option and successful land-reclamation. The worst alternative represents the impossibility that a layer of original fertile soil (O and A horizon) be preserved.

In such cases, the success of land-reclamation is limited. Selective mining and dumping of the layer of fertile soil represents the best solution and guarantee of a successful land-reclamation, as well.

The above stated completely explains (support) the necessity, urgency and importance of preparing of this Study, and indicates that the problems concerning the selected excavation and dumping of overburden along the coal open pit mines in EPIS, land-reclamation, revitalization and spatial arrangement of the soil of exploitation fields, should be in a function of a feedback and the observed multidisciplinarity.

2. PAST TECHNOLOGY OF OVERBURDEN AND COAL MINING

Production of coal represents one of the two most predominant production activities of EPIS. Out of the total number of the 52,000 employed in EPIS, about 25,000 is engaged in coal production. At the beginning of the 1990s, along with the imposing the sanctions within the country, the coal production at open pit mines decreased from 35 to either 28 or 30 million tons per year. This period is characterized by the minimization of income, lack of investments, followed by deteriorated work conditions, and accordingly, significant decrease in reliability of work and availability of capital mining equipment, as well as the reduced and delayed overhaul.

Coal exploitation, mining, conveyance and dumping of overburden at open pits is carried out by continuous technology. The common characteristic of the applied work technologies at open pit mine of the Kolubara coal basin, is that the same have not been designed for selective mining and dumping of overburden.

From the point of view of the target aim of the subject Study, this fact opens a large and demanding engineering problem of analysis and estimation of selective mining and dumping overburden feasibility. Selective mining and dumping of overburden of heteregoneous lithological composition has conflict-multi criterion dimensions where effects of possible solutions should be considered through the problem of land-reclamation and revitalization of the spaces exposed to exploitation works and cost-profit analysis.

3. POSSIBLE TECHNOLOGICAL PROCEDURES OF SELECTIVE MINING OF SOLUM OR ITS PART FROM OVERBURDEN

Land-reclamation of waste dumps of the Kolubara open pit mines represents a set of works at the waste dump surfaces by which the deposited masses are prepared as the soil suitable for returning to the original natural functions aimed for agricultural development, forestry and other useful purposes. In order to make land-reclamation a successful one, the same should meet the functional and economical requirements (criteria), should be technically and biologically feasible with the aim to arrange the surface and create multiple purposes soils.

For economic and technical reasons, the technical land-reclamation in principle, should be adjusted with mine works at open pit mines, namely it should be carried out simultaneously with the mining and dumping of overburden works. Technical land-reclamation with selective mining, conveyance and covering of fertile soil (solum) at the final waste dump surfaces might be carried out:

- **Unified** (simultaneous) with the technological process of mining, conveyance and dumping of overburden from the highest pit level,
- **Separated** (individual) from the technological process of mining the overburden at the open pit mine. Mining of fertile soil (solum) is carried out separately in front of the system for overburden mining at the highest open pit level, as well as the conveyance of fertile soil from the open pit mine to the waste dump and dumping.

Unified selective mining, conveyance and dumping of solum incorporates utilization of available ECS system equipment running at the top level of the open pit mine. Bucket wheel excavator running at the top level (under terrain surface) in the height block selectively mines the solum. In the first cut of the height

block, with the cut height equivalent to the thickness of solum, the excavator mines the fertile soil, that further on is conveyed by the existing conveyors up to the spreader at the waste dump. The spreader deposits the solum mass over the top part of the dumping mass thus forming the surface with fertile soil required for biological land-reclamation. Upon completion of one cycle of bucket wheel excavator mining of solum (deep down to the full cut depth), the excavator continues with mining of the remaining part of overburden in the height block. The spreader deposits those masses in the height block at the dump, representing a basis for the next solum laying. The deposited solum masses are levelled by bulldozers.

The separated scheme of selected mining, conveyance and dumping of solum is carried out by specific equipment containing: - discontinuous equipment (several combinations possible); - continuous equipment (excavator, belt conveyor and spreader).

4. CONCLUSION

The model of unified manner of working of ECS system with selective mining of fertile soil in function of waste dump land-reclamation consists of: The bench of bucket wheel excavator running at the open pit directly below the terrain surface, should be divided vertically so that the first cut excavates only the fertile soil, while the other cuts excavate the waste being below the fertile soil. In relation to the technological scheme of non-selective mining, this scheme differs in change of the bench height also. Significantly lower thickness of the fertile soil, compared to the diameter of the working wheel of the bucket wheel excavator, causes the height of the first cut to be lower than the optimum one.

The block height of the bucket wheel excavator with selective mining of fertile soil is reduced between 5 and 10(%), depending on the working wheel. All other technological characteristics of the excavated block remain unchanged. By reducing the height of the first cut to the thickness of the fertile soil, the capacities of the bucket wheel excavator are also reduced. The analysis shows that the entire capacity of the bucker wheel excavator in the height block, during selective mining of the fertile soil, is reduced between 5 and 20(%). With conveyance during the selective mining of the fertile soil, no changes occur, except the reduced utilization of the installed capacity in the phase of solum mining, that otherwise reduces the entire capacity efficiency of the ECS system by the same percentage appearing with the bucket wheel excavator.

Technological running scheme of the spreader that selectively dumps the fertile soil and waste differs in relation to the scheme of non-selective overburden mining. The height block of spreader remains unchanged according to the height. The width of the block is reduced in order to provide for the smooth conveyance of the spreader in the phase of the fertile soil spreading. The length of the spreader block (for one cycle of the bucket wheel excavator) is longer and is also in function of decreasing the block width. Determining the dimensions of the spreader block should be grounded on the equalizing the volume of the mining block and dumping block, taking into consideration the coefficient of loosening, mass quantity of the fertile soil and waste, as well as the condition that the spreader might smoothly lay the fertile soil over the waste. The dumping process is carried out in two phases. In the first phase a block from waste is formed being excavated by the excavator below the fertile soil. When the bucket wheel excavator started cutting the fertile soil, the spreader moves along previously formed waste block and continuously spreads the fertile soil over it.

5. LITERATURE

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