ECOLOGICAL PROBLEMS OF COAL OPENCAST MINING

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ABSTRACT


Paper discusses the numerous problems referring on opencast mining of coal. Besides social problems - migrations of population, translocations of settlements, industry, traffic, cultural-historical and other facilities that are situated above the coal deposits, lignite extraction based on large-scale opencast mines, produce multiple degradation of environment. Paper also gives the example of successful biological recultivation by afforestation, landscaping and multifunctional use of degraded areas in Kolubara basin.

Key words: coal opencast mining, ecological problems, environment, biological recultivation, afforestation, landscaping.

Introduction

In most countries coal, especially lignite (or brown coal) is major energy raw material and the base of the industrial and economic development. Extraction of these coals worldwide is based on large-scale open-cast mines, which produce multiple degradation of the environment.

The main characteristic of opencast mining is large-scale occupation of different types of land, mostly agricultural and forestland, but also translocations of settlements, industry, traffic, cultural-historical and other facilities that are situated above the coal deposits, lignite extraction based on large-scale opencast mines, produce multiple degradation of environment. Instead of previous landscapes and ecosystems, artificial sterile mine spoil banks, immense holes - craters, areas without vegetation and with destroyed soil cover, formations of lakes, pools and other water bodies give a completely new image of disturbed landscape.

As the result of different mining activities, coal preparation industries and gas and other pollutants from the thermo power plants, the region is multiply damaged during the long period.

Material and Methods

Researching has been done in the Kolubara coal basin, one of the greatest coal basins in Serbia, formed by the deposition and carbonization of biomass in the Tertiary marshes and lakes. Researching included: ecological conditions, geological, paleopalinological and soil research, phytocenological characteristic and the directions of natural species succession, monitoring of the development and classification of tree species, and the assessment of potential suitability for recreation after the recultivation and landscaping process.

Results and Discussion

The study area is characterized by the temperate continental climate (Kerner), subhumid, moister type (Thornthwaite) with mean annual air temperature 11.0-12.0°C and rainfall ranges between 584 and 783 mm.

In the course of opencast mining, the previously natural soils in this area – brown forest soil, pseudogley, smonitza, meadow soil, hydromorphic black earth, mineral-marsh soil, alluvium, alluvial-deluvial and deluvial deposits – were placed by mineral-spoil banks, originating from different geological layers. Pontian sands and heavy Pliocene clay are the most often found on the surface of spoil banks in the case
of nonselective deposition. The knowledge of the structure of the geological column, especially the layers above the coal seam, is very significant, because in the process of coal extraction and depositing overburden, all the materials occur as the substrates used in recultivation. This refers to the non-selective method of depositing overburden, which is the most prevalent method in Kolubara region. Very heterogeneous substrates are, after Antonovic (1980) in the class of anthropogeneous soil, i.e. after Resulovic (1983) and Skoric (1985) in the special class of technogenic soils, type deposols, subtype deposols formed by opencast mining of lignite. The deposols of the study area have very variable properties, which is the consequence of different initial characteristics of the deposited material. According to their textural class, depending on the dominant structure of the profile part where the root system develops most intensively, the deposols were classified into deposols of lighter mechanical composition (sandy-loam texture with more or less clay particles) and more heavily textured deposols (clay-loam or clay textural classes). Chemical properties are characterized by a very low amount of total humus and organic matter and by a weak acid to neutral reaction of the soil solution. The analysis of soil micro-flora in all samples plots shows that the biogeny of substrates was restituted under the influence of forest plantations. All the basic physiological groups of microorganisms are recorded in all the profiles and analyzed layers. The analyses of the soil microflora show the revitalization of all the substrates. The activated microbiological processes caused the initiation of soil processes and introduced these soils in biological circling.

The survey of autochthonous vegetation shows a very diverse plant life and forms in which it appears, from swampy areas and pools and marsh vegetation, through lowland and hilly meadows and pastures, to numerous forest communities. The floristic wealth of this region is a significant factor of its polyfunctional intention and complex use. In the damaged parts of the basin, primarily by opencast mining and the related industries, the image of the landscape has been drastically changed. The spectre of spontaneously occurring plant species is considerably narrower, and the forms are different. On the minespoil banks – deposols, some species of trees, shrubs and herbaceous plants occur spontaneously. Their appearance reflects and follows the laws of micro-ecological conditions of the environment, primarily the soil, moisture, altitude, exposure and terrain. There are registered species from Populetalia albae Br.-Bl. 31, Phragmitition communis Koch. 26, Arrhenatheretalia Tx. 37, Salicion albae Soo (30) 40, Sambuco-Salicion capraeae Tx. 50, Magnocaricion elatae W.Koch. 37, Querco-Fagetalia Br.-Bl. et Vlieger 37, Fagetalia Pawl. 26, Quercetalia pubescentis Br.-Bl. 31, Festuco-Brometea Br.-Bl. Et Tx. and Nardo-Callunetea Preising. The recorded species present the state at the moment of plant community surveys, but it should be taken into account that these areas are very dynamic, the succession of vegetation is continuously progressing. With the development of pedogenetic processes and with the formation of adult forest stands, the new, more complex phytocoenological relationships are being established.

Monitoring of the development and classification of the tree species used in the process of biological recultivation by afforestation, assessment of their vitality, ornamentality and other characteristic shows that:

- The elements of the study species development in forest plantations (diameter, height and volume) have satisfactory results. As for tree diameter, on the deposol of lighter mechanical composition, at the age of ten years, the best results show Alnus glutinosa (L.) Gaertn. (12.3 cm), then Larix europaea L. (11.7 cm), Sequoiadendron giganteum (Lindl) Buchh. (10.7 cm), Cupressus arizonica Greene (10.6 cm), Pinus excelsa Wall. (10.4 cm), Pinus ponderosa Law (9.4 cm), Pinus strobus L. (8.6 cm), Pseudotsuga menziesii (Mirbel.) Franco. (8.6 cm), Pinus sylvestris L. (8.3 cm), Betula pendula Roth. (8.1 cm), Cedrus atlantica Man. and Pinus nigra Arn. (7.3 cm), Chamaecyparis Lawsoniana (Murr) Parl. (6.9 cm), Libocedrus decurrens Torr. (6.3 cm), Quercus rubra Du Roi non L. (5.1 cm), Abies nordmanniana (Stev.) Spach. (4.8 cm), Picea omorika Panc. and Liriodendron tulipifera L. (4.4 cm). The majority of species showed considerably better results on deposols of lighter mechanical composition. In general, all the study tree species used in biological recultivation of deposols show high development results, even if they are compared with the development of the same species in forest plantations of various natural, anthropogenically undamaged soils.


The evaluation of potential suitability of the study area for recreation in post-exploitation phase, after the biological recultivation by afforestation and landscaping, showed that 87% of the evaluated area (1 143 ha) belongs to the first and second categories of suitability for recreation in landscape, which is an ex-
traordinary quality. Significant presence of forests, water bodies such as lakes, rivers and marshes, areas of meadow type and low percentage of arable fields, settlements, infrastructure and competitive uses, gives opportunity for the different recreation activities.

Conclusion

In spite of drastic ecological, social and other disturbance and environmental degradation of large areas during the opencast coal mining process, with the appropriate technical and biological recultivation by afforestation and landscaping, we can create enhanced spaces, which can be used for multiple benefits. For this reason, law must regulate the plan of land use. The plan of land use after the extraction of mineral raw materials by opencast mining must also include the planning documents, which define clearly the ratio of different types of recultivation (agriculture, forest, spontaneous etc.). The selective deposition of overburden must be obligatory, as well as the formation of optimal soils for agricultural and forest recultivation. The plan must regulate the translocation of the new settlements, movement of the population, infrastructure and roads. Parts of the space in the zone of influence of opencast mining must be spatially defined and adapted for recreation in landscape, considering the demands of the new social structure of the population. There are also much wider possibilities for employment of inhabitants: industry, agriculture, forestry, nurseries, wood industry, production of biofuels, etc.

The study of potential uses of newly created landscapes and ecosystems after the technical and biological recultivation by afforestation, confirms the thesis of sustainable development and sustainable exploitation of coal. It is not unavoidable that the degraded spaces are irreversibly lost. With correct and uncompromising legal regulations, based on the implementation of scientific results, the degraded spaces can be enhanced and used for multiple benefits.

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Summary

In most countries coal, especially lignite (or brown coal) is major energy raw material and the base of the industrial and economic development. Extraction of these coals worldwide is based on large-scale opencast mines, which produce multiple degradation of the environment. The main characteristic of opencast mining is large-scale occupation of different types of land, mostly agricultural and forestland, but also translocations of settlements, industry, traffic, cultural-historical and other facilities that are situated above the coal deposits. Degradation and destruction of various ecosystems and drastic change of landscape, occurs on large areas. Minespoil banks originating from different geological layers replace natural soils. Surface and underground water regime is changed. Food chains are broken which is followed with other changes of biocenoses. Instead of previous landscapes and ecosystems, artificial sterile mine spoil banks, immense holes - craters, areas without vegetation and with destroyed soil cover, formations of lakes, pools and other water bodies give a completely new image of disturbed landscape. As the result of different mining activities, coal preparation industries and gas and other pollutants from the thermo power plants, the region is multiply damaged during the long period.

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