DEGRADED AREA OF VELIKI KRIVELJ QUARRY RECULTIVATION

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Abstract

Veliki Krivelj Quarry is located north of Bor, near the village of Brezanik. Itoperates within Serbia Zijin Copper doo Bor. During the exploitation of limestone, waste material was obtained, which is deposed of in the southeast in relation to the quarry. In order to protect the environment and improve the landscape, an analysis will be performed to determine the optimal method of recultivation. Using technics of technical and biological recultivation, a new ecosystem will be established and the degraded areas will be translated into their new function.

***Keywords**: quarry, waste dump, waste, recultivation.*

1. INTRODUCTION

The Veliki Krivelj Quarry operates within Serbia Zijin Copper doo Bor. It is located north of Bor, at a distance of about 4.5 km, near the village of Brezanik (Figure 1). Of the larger facilities nearby, there is the Veliki Krivelj flotation plant and the open pit Veliki Krivelj. The main goal of obtaining limestone is for smelter Bor needs. During the exploitation of limestone waste was obtained, which is deposited southeast in relation to the open pit (Figure 1).

The morphology of the terrain Kriveljski kamen is such that it is located within the hill that dominates the surroundings (Figure 1). The terrain with the lowest elevation of 350 m is at the foot of the hill at the confluence of the Ujova and Kriveljska rivers, while the highest elevation at the top of Kriveljski kamen is 655 m.

The Kriveljski kamen limestone deposit is isolated in the central part of the deposit and there is no natural boundary on all sides (Figure 1). The deposit is built of Cretaceous sediments: limestone, marble and andesite (phase II) and of Paleogene marbles and quartz dioritporphyrite breakthroughs, of which limestones and marbles are the most widespread. Limestones are characterized by low compactness, they belong to the crack-cavernous type with tectonic fracture along faults. Along the caverns and fault lines, which are usually filled with the decomposition products of the original basic mass, it is possible for water to penetrate into deeper parts of the reservoir.

Figure 1. Spatial view of Quarry Veliki Krivelj location

2. DEGRADED AREA

Exploitation of limestone at the Veliki Krivelj Quarry implies degradation of the surrounding area during the formation of the projected contours of the open pit. The total area that will be degraded is 48,735 m^2. The projected waste dump occupied an area of 8,760 m^2, and the projected open pit area of 39,975 m^2.

Open pit and waste dump degraded areas are intended for landscaping by applying recultivation for raising forest plantations.

During the exploitation of the Veliki Krivelj quarry, no layers of soil material were found, even in the surface layers, due to the characteristic terrain, while the obtained waste will be disposed of at the designed waste dump.

Since the recultivation requires soil material that is used to fill the seedling pits, it is necessary to obtain it, in this case, from the area near quarry.

The total area where soil material will be obtained is 3,010 m^2. Bearing in mind that 20-30 cm of surface layer will be used, a sufficient amount of soil material was obtained to perform recultivation. The location plots that will represent the borrowing of soil material are located southeast of the open pit and south of the waste dump.

3. CHOOSING RECULTIVATION METHOD

The main goal of recultivation of physically, chemically and biologically damaged soils is to establish the function of land management, as a resource that is disturbed by anthropogenic activities.

The goal of reclamation is to "return" in some form, through the activities envisaged by the recultivation project, what was previously borrowed from nature through exploitation.

For the reclamation of the quarry Veliki Krivelj, reclamation with the method of afforestation is proposed. Reclamation works take place in the following phases of reclamation:Technical phase of reclamation and Biological phase of reclamation.

4. TECHNICAL PHASE OF RECULTIVATION

Technical reclamation includes the areas of the plateau of the waste dump and all benches of the open pit.

The technical phase of reclamation at the tailings dump at the Veliki Krivelj Quarry represents the stage of preparatory works (subsequent leveling of the final plane), which enable the performance of biological reclamation. Subsequent planning or leveling of the final bench (plateau) is done with a bulldozer before the start of recultivation. During the final process of disposal of the last excavated piles of tailings on the final plane, due to the stability of the landfill, they are not leveled (the piles do not allow the formation of ponds and lakes during atmospheric precipitation and infiltration of water in the landfill body). The bottom of the open pit will also be leveled.

After this phase of technical recultivation, the degraded areas for planting will be prepared, ie the formation of pits for seedlings on the open pit benches and the plateau of the tailings dump.

This implies the process of drilling and blasting in order to form (excavate) pits (funnel) for seedlings on the benches of open pit. This is necessary because it is such a type of substrate that the pits cannot be dug by hand or by mechanization.On the plateau of the tailings dump, pits for seedlings will be excavated by machine because it is a matter of filled material, so the base is adequate for this type of excavation.

After that, the soil material is transported to the benches of open pit and the plateau of the waste dump, which will be used to fill the pits for seedlings.

5. BIOLOGICAL PHASE OF RECULTIVATION

The biological phase of reclamation implies a complex of biotechnical and phytomeliorative measures for growing forest crops on the prepared surfaces of open pit and waste dump in order to greening and restore ecosystems.

The most effective measures to prevent erosion and improve landfill stability is afforestation. [1]. The development of seedlings leads to better binding of the substrate in the landfill, which prevents erosion, as well as raising dust by the wind [1].

The biological phase of reclamation includes afforestation of all areas of waste dump and open pit.

Pits made as part of technical reclamation will be used for afforestation. Planting seedlings is done manually. During planting, the seedlings are also fertilized with mineral fertilizer.

Pits for seedlings are dug in two rows at a distance of 3 m from each other on the flat surfaces – open pit benches.

The bottom of open pit is at K + 540 m and represents a flat surface in the limestone and when the exploitation at the open pit ceases, this area will be intended for raising forest plantations (Figure 2).

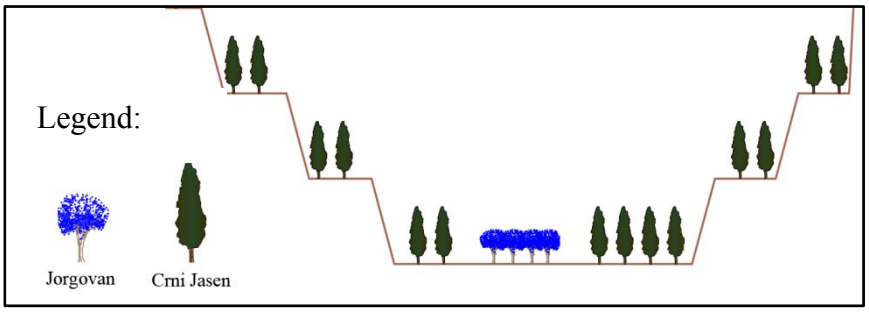

Figure 2. Profile of a surface mine with the arrangement of plant cultures

For greening of degraded areas at the subject location, the biological method of recultivation will be applied, as follows:

- Shrubby plants: Lilac - Syringa vulgaris. As this crop is drought resistant and is satisfied with modest soil, gives abundant root shoots, it was chosen for afforestation of degraded areas.
- Woody plants: Black ash - Fraxinus ornus L. It was chosen because of its characteristics to bind the soil well on steep terrain.

Lilac - Syringa vulgaris, which is a deciduous shrub, was chosen as a shrubby plant. It is a natural habitat in Eastern Serbia and the Ibar Valley. It has excellent characteristics that are necessary for the subject area, the most important of which is that it is resistant to drought, is satisfied with modest soil and gives abundant root shoots. It is also valued as an ornamental plant and is often grown in backyards and parks.

The woody plant that will also be used in biological reclamation is black ash. A tall tree that can grow up to 20 meters in height. It thrives on rocky and shallow skeletal soils, suitable for areas with steep terrain up to 1200 m above sea level.

Planting deciduous shrub crops means a square pattern, on flat surfaces, with a mutual distribution of 2.24 m, and about 2000 seedlings can be planted on one hectare.

The planting of deciduous trees at the bottom of the open pit and the plateau of the waste dump will be done according to a square scheme at a distance of 3 m from each other. This means that 1,100 seedlings can be planted on one hectare.

Planting deciduous trees on the benches of a open pit, since the width of the floor is 7.5 m, it is possible to plant trees in two rows according to a square scheme at a distance of 3 m from each other. This means that 1,100 seedlings can be planted on one hectare.

In order to determine the total cost of procurement of seedlings, it is necessary to determine the total number of seedlings. This number is determined based on the areas covered by these crops. The total required number of seedlings for planting has been determined, and amounts to:

- for lilac- 91 seedlings
- for black ash - 2385 seedlings

5.1 PLANTING METHOD

The general rule when planting seedlings is to plant the plant 1-2 cm deeper than the position in which it was in the nursery. When the soil around the seedling settles, the root collar will be at ground level.

Up to 1/3 of the height of the earth is first inserted into the excavated pits. The seedling is placed vertically in the pit so that the root veins take as natural a position as possible along the entire depth. The remaining amount of soil is poured on the root of the plant to fill the seedling pit so that the root neck is 1-2 cm below the level of the trampled soil. After planting, tread the immediate surroundings of the seedling well in order to compact the soil, thus eliminating the danger of forming "air pockets" along the root of the seedlings, which lead to drying of the seedling. According to previous experiences, the most common cause of poor seedling reception is, in addition to the lack of moisture in the soil, improper planting.

Healthy seedlings with a free root system, age 2 + 1, are used for planting. 150 g of NPK (15:15:15) of mineral fertilizer is added per planted seedling.

Fertilizer is added around the planted seedling only when the root is completely covered with soil, ie the pit is filled. In the spring, when hoeing, fertilize the seedlings with KAN in the amount of 100 g per seedling.

6. CONCLUSION

Occupying large areas of land, ecosystem degradation and population relocation, ie. changes in the network of settlements are, of course, the most significant structural changes caused by the exploitation of mineral resources in large mining basins [2]. To this should be added the relatively high degree of pollution of the environment: air, water, soil and wildlife from harmful emissions from the industrial complex [2].

Recultivation and revitalization of the space is the last, very important phase (after the end of exploitation) and requires appropriate planning activities for its implementation.

Today, significant results are being achieved in the world on the restoration of degraded land. Restored areas sometimes reach a higher ambient value compared to the state before the start of exploitation.

In this case, the effects of reclamation of degraded areas are reflected in the fact that:

- Forest plantations enable better binding of the soil, stimulate the development of ground flora, activate pedological processes in the substrate by the root system, prevent insolation and drying of the soil, blowing strong winds and raising dust.
- Afforestation of degraded areas contributes to environmental protection, improvement of the microclimate and aesthetic appearance of the environment.

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