

DEGRADED AREAS RECLUTIVATION ON LOCATION OF OPEN PIT ZAGRAĐE 5

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ABSTRACT – In order to protect the environment and improve the landscape, the degraded areas created by the exploitation of limestone at the open pit Zagrađe 5, will be recultivated. The goal of recultivation is to "return" in some form, through the projected activities, what was previously borrowed from nature through exploitation. Recultivation will take place according to the following phases of recultivation: technical, agrotechnical, and biological phase. In this way, i.e. by applying biological recultivation, seedlings of black ash, hornbeam and lilac are planned. The alternating combination of these plant species enables the binding of the substrate and gives a beautiful aesthetic appearance to the environment.

Keywords: Environment, Recultivation, Exploitation.

INTRODUCTION

The limestone deposit of Zagrađe is located 12 km east of Bor. The exploitation of limestone in the area of Zagrađe began in 1962 and took place in open pits 1, 2, 3, 4, and currently only the open pit Zagrađe 5 is active, which was opened in 1970.

The main goal of obtaining limestone is the production of baked lime in lime kilns for the needs of flotation in Bor and Veliki Krivelj in order to regulate the pH value during the flotation of copper ore. In addition to industrial lime, the lime plant produces hydrated ground lime for construction and gravel. When crushing limestone, smaller fractions are obtained than needed for lime kilns. During the firing of limestone, lime filler was obtained as waste, which is used in agriculture to repair the pH value of the soil.

The location of Zagrađe is located in the area between the village of Slatine (west), the village of Rgotina in the east and the village of Donja Bela Reka (in the north) (figure 1). The area where the open pit and Krečana Zagrađe are located is sparsely populated. There are small huts, which have been abandoned, because their owners have houses in the surrounding villages for permanent residence. The access road to the Zagrađe limestone plant (K + 220 m) is separated from the regional asphalt road Bor - Majdanpek at K + 195 m (road 166).

The surface mine Zagrađe 5. is located 2.5 km from the lime production plant in Zagrađe and is located at about K+410 m. During the exploitation of limestone, barren material was obtained, which is disposed of to the east in relation to the surface mine, at the existing tailings dump.

The lime production plant is located at K + 220 m above sea level. The access road to the Zagrađe plant is separated at K + 195 m from the asphalt road Bor - Majdanpek.

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Figure 1 Location of the mining complex Zagrađe

DEGRADED SURFACES

A discontinuous exploitation system will be applied at the open pit Zagrađe 5. Exploitation of limestone at the open pit Zagrađe 5 implies degradation of the surrounding land during the formation of the projected contours of the open pit.

The existing location east of the Zagrađe-5 mine was chosen for the disposal of tailings obtained during the exploitation of limestone (Figure 2). The soil material obtained by expanding the open pit in the southeastern part will be deposited at a new location, landfill placed south of the open pit Zagrađe-5 (Figure 2). Also, before the advance of the tailings dump continues, the existing quantities of soil material will be moved from the current location to the new location of the soil landfill.

This is important because the soil material can later be used as a final layer when performing biological recultivation of degraded areas.

The total area that has been degraded is 241370 m². The projected tailings dump occupied an area of 54.370 m², and the projected area of open pit is 187.000 m².

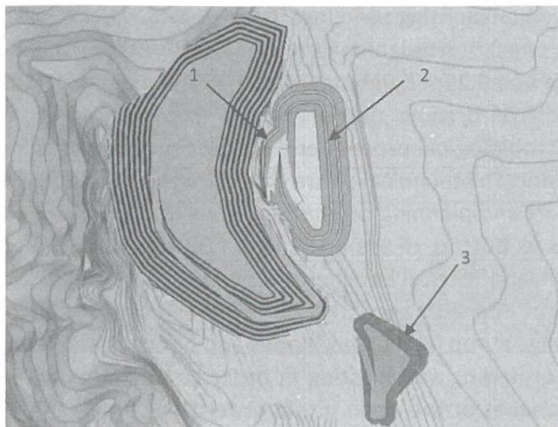


Figure 2 Spatial layout of facilities: open pit (1), tailings dumps (2) and landfill of soil material (3)

CHOICE OF 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 recultivation is to "return" in some form, through the activities envisaged by the recultivation project, what was previously borrowed from nature through exploitation.

The share of nutrients in the substrate of surface digging and tailings at the dump is insufficient for normal plant development and in order to quickly green the degraded areas created by surface exploitation of limestone and tailings dump, the soil material should be used for biological recultivation. In the world and in Serbia, three categories of recultivation are used. For recultivation in Zagađe, recultivation with afforestation and grassing methods is proposed. Recultivation works take place in the following phases of recultivation:

1. Technical phase of recultivation,
2. Agrotechnical phase of recultivation,
3. Biological phase of recultivation.

TECHNICAL PHASE OF RECULTIVATION

The technical phase of recultivation at the tailings dump at PK Zagađe 5. represents the stage of preparatory works (subsequent leveling of the dump final plane), which enable the implementation of agro-technical and biological recultivation. Subsequent planning or leveling of the dump final plane 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 level, 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 next stage involves the application of soil material. Earth material will be used for:

- formation of a 0.5 m high layer on a dump final plane;
- filling pits when planting seedlings;
- formation of a 0.5 m height layer at the bottom of the open pit;
- application of a 0.25m height layer at the dump slopes and benches.

The introduction of organic matter in the form of humus into the substrate accelerates the microbiological process and enables a continuous influx of assimilators for plant development. The technical phase of recultivation includes loading soil from the soil landfill, transport and planning on the final level of the tailings dump K + 420m and the lowest benches ie. bottom of the open pit K + 335 m. Also, the soil will be transport from location of soil landfill to all benches of open pit.

The agrotechnical phase of recultivation includes leveling and planning of the soil layer along the tailings dump final plane, slopes and benches and the bottom of the open pit and the phase of drilling and blasting in order to form (excavate) pits (funnels) for seedlings on the benches of the open pit. In order to optimize the works, the works of the agro-technical and technical phase are supplemented, and thus the maximum utilization of machines and shortening of the time of completion of works are obtained.

AGROTECHNICAL RECULTIVATION

The agrotechnical phase of recultivation includes leveling and planning of the soil layer along the tailings dump final plane, slopes and benches and the bottom of the open pit and the phase of drilling and blasting in order to form (excavate) pits (funnels) for seedlings on the benches of the open pit. In order to optimize the works, the works of the agro-technical and technical phase are supplemented, and thus the maximum utilization of machines and shortening of the time of completion of works are obtained.

BIOLOGICAL PHASE OF RECULTIVATION

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

The most effective measures to prevent erosion and improve the stability of the landfill is afforestation [1]. Development of seedlings comes into a better binding of substrate in the landfill, thus preventing erosion and also raising dust from the landfill through the wind [1]. Seedlings with crowns and green leaves prevent drying, whereby micro-climatic conditions become more favorable. Falling of leaves in autumn and their retention in the denuded areas and rotting over the winter, create conditions for formation of humus and opportunities of auto-recultivation and occurrence of terrestrial flora.

The biological phase of recultivation includes the following works:

- On the final plane of the tailings dump, grassing and afforestation according to the mosaic arrangement of crops;
- On the slopes and floors of the tailings dump, grassing and afforestation according to a triangular pattern;
- At the open pit bottom, grassing and afforestation according to the mosaic arrangement of crops;
- Afforestation on the benches surfaces of the open pit.

The final level of the tailings dump for the purpose of landscaping is filled with a 50 cm height layer of humus. After that, the grassing of this area will be done. Planting of plant crops: black ash, lilac and hornbeam will be done according to the mosaic schedule.

Along the perimeter of the outer slope of the landfill, soil material is poured in a layer of 0.25 m. The slope is grassed. After that, a protective belt of lilac, hornbeam and black ash is formed.

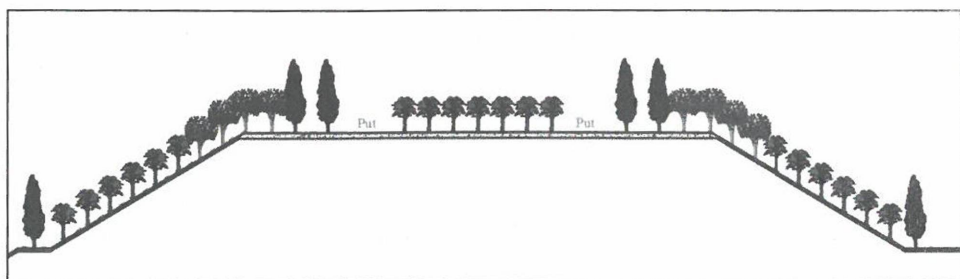


Figure 3 Cross-section of landfills with crops

On the slope of the landfill (405/390), in horizontal rows according to the triangular pattern, black ash is planted in round pits with a diameter of 40 cm and a depth of 40 cm at the landfill benches, and on the slopes hornbeam seedlings and at the top of the slope lilac.

Black ash will be planted on the open pit benches, in horizontal rows as shown in Figure 4. The open pit bottom will be worked in several phases. First, a layer of soil material in the height of 0.5 m will be applied. After that, the entire surface will be grassed. Planting culture: black ash, hornbeam and lilac is planned to be done according to a mosaic arrangement (Figure 4).

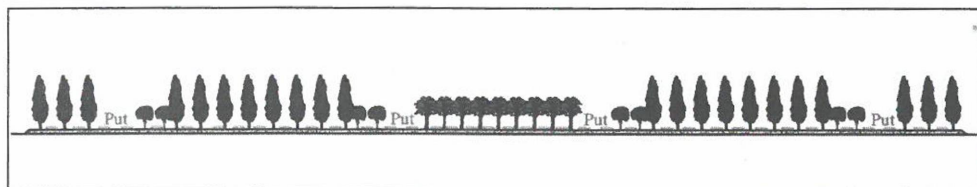


Figure 4 Cross- section of open pit bottom with crops

SELECTION OF SEEDLINGS

It was concluded for the biological stage of recultivation the degraded areas that it is best to apply the species growing in natural conditions in the same or similar fields in Serbia, and they are: lilac, hornbeam and black ash.

Number of plants per hectare is 1100 of black ash and lilac and hornbeam of 2,000 seedlings per hectare respectively.

SELECTION OF GRASS-LEGUMINOUS MIXTURE

The grass mixtures should be used to raise the grass areas, as follows: white clover, yellow star, cat's tail, real meadows. The required amount of grass-leguminous mixtures for planting the predicted area is 25 kg/ha.

The following properties were taken into consideration in selection the above given grass-leguminous mixture to raise the lawn: resistance to the specific environmental conditions, tolerance to the climatic conditions, prevalence, ground cover, binding capacity of the substrate, etc.

CONCLUSION

The effects of recultivation 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.
- The application of grass cover on the final planes aims to prevent the erosion of humus (soil) applied in a layer 50 cm high and to enable the creation of grass surfaces that could be used for recreational purposes.

- Afforestation of degraded areas contributes to environmental protection, improvement of the microclimate and aesthetic appearance of the environment.

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