

ECOLOGICAL REHABILITATION OF SFÂNTU GHEORGHE AND BODOȘ OPEN PITS

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Abstract: Exploitation of mineral resources in quarries, lead major changes in surface and consequently a major impact for the population. In some cases the stability of soil or construction may have catastrophic effects. Thus rehabilitation of land affected and reduce or eliminate the effects of pollution are major problems in the closure of mining activity. For this purpose it is necessary to achieve ecological rehabilitation measures for the affected areas. Present research is a summary of a comprehensive study related to mine closure activity in the SNC Ploiesti.

Key words: coal, quarries, mine closure, stability, environmental rehabilitation

Introduction

National Coal Society S.A. Ploiesti was set up by reorganization of Autonomous Administration of Coal Ploiesti which was abolished in 1997. Today eight mine exploitations situated in eight districts are part of it and it ensures the power coal necessary for the thermo-electric power stations from Bacău, Brașov, Zalău and Oradea.

At the moment most of the underground exploitations are closed, except from Jugur sector from Câmpulung area, Argeș County. Aninoasa, Argeș County, Racos from Covasna county open pits and Filipești and Ceptura from Prahova county open pits are also part of the exploitation.

As far as the environmental impact is concerned, the most productive coal-wise lignite open pits through time were the two subunits in Covasna County, Sfântu Gheorghe and Bodoș open pits.

Mining objectives closure and ecological reconstruction of the exploitation affected areas activity is one of the most complex activities after mining and exploitation of mineral resources [1]. Bodoș and Sfântu Gheorghe open pits were surface lignite exploitation units, being set up in 1987. Because of the economical inefficiency

mainly due to the poor quality coal exploited production stopped at the end of April 2004. The total volume of the stripping is 16 millions m³ and the exploited production is 2.000.000 tones of lignite which was used to produce electricity and heat homes.

Ecological rehabilitation of the areas affected by lignite exploitation from Bodoș and Sfântu Gheorghe open pits aims to re-establish the ecosystems structurally and functionally as well as to ensure the abiotic and biotic resources necessary for sustainable development.

Geology of the area

Baraolt post-tectonic sedimentary basin has a relatively complicated geology because of the basin building-up geo-tectonic processes and further coal carrying strata driven processes as well as specific deposition processes that generated coal layers storage. The mining area is located in the southern extremity of Barsa depression, formations consisting of molasses deposits with Pliocene-Pleistocene coals which are on top of Cretaceous flysch deposits.

The deposit is composed of ten variable thickness and extension coal layers determined by deposition conditions and Cretaceous bedding configuration.

The proper coal-bearing complex is characterized by an interchange of grey sands, sometimes andesite, yellowish grits, tufaceous clays, coal-bearing clays, purple or green-blue clays and coals. Within the subsystem, the three coal layers are composed of multiple layers, being solid only rarely. Only layers I and III have economical value. This subunit is from the Late Pontian age. Layer III is the layer with the maximum growth in the basin, being 2-8.6 m thick and it is situated 8-130m deep in the roof of layer I [3].

The impact caused by the exploitation

Bodoș open pit abolishment does not have a major socio-economic impact because the majority of the staff has been redistributed to Racos-Sud open pit, an open pit that is productive.

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By abolishing Bodoş and Sfântu Gheorghe open pits it has been achieved:

- Disposal of the noise in the area produced by typical machinery in the open pit and on the road leading to it that crosses Bodoş village.
- Disposal of the dust in the air produced in the open pits, waste dumps and on the road
- Disposal of solid suspensions from the streams next to the open pits and the waste-dumps
- Re-establishment of the natural aspect of the areas affected by open pits and waste-dumps and improvement of the surface soil,

Re-establishment of the natural aspect will take into consideration the wooded areas before opening the quarries as well as the mainly hay tamed areas

Coal exploitation in the open pits has produced and will produce an impact caused by used industrial and domestic water evacuated from the open pit, an impact produced by water management and an impact produced by dewatering produced water evacuated from the open pit.

Transporting coal on the exploitation road and on the public road has affected the infrastructure of the public road, damaging the bridge over Baraolt brook, damaging the guard ditches, the public road, dust suspensions air infestation and damaging over 80 ha of land which will be subject to modelling and greening.

Lignite exploitation in the open pits affects the qualities of environmental factor air by dust, smoke and gas emissions.

Sources of dust emissions are coal deposits, deposits of waste rock from the damp, excavation areas, access roads from the waste-dumps and the open pits as well as the slopes and open pits terraces, open pits affected by climatic factors and uncovered by vegetation. Air pollution in these areas is a physical one.

Auto-ignition of coal from the open pit slopes or deposits emits fumes and pollutants that are spreading into the atmosphere. The impact of coal mining activities on the soil and subsoil is both qualitative and quantitative.

Quantitative impact on the ground translates into open pit, external waste-dump, utilities, land with permanent or temporary productive, agricultural or sylvan circuit removal employment, fig 1.

Another form of manifestation of the impact is the change of the terrain features in the natural area which has objectified through other forms of terrain. Qualitative impact is manifested by destroying the natural geo - lithology of the land up to more than 150 m deep due to stripping work for coal extraction.



Fig.1. The impact on the soil

The impact on the soil in the area is manifested by physical pollution with coal dust and sterile as well as by erosion and landslides which leads to decreased fertility of the surrounding areas.

It can be concluded that the main and auxiliary activities carried out in the open pits have had a major negative impact on the environment as a whole, changing the relations between environmental components on a 300 ha area almost completely.

Ecological rehabilitation of Bodoş and Sfântu Gheorghe open pits

Abolishment and economic restructuring of lignite exploitation is one of the present subjects of the Romanian mining industry which tries to comply with the EU requirements.

The restructuring process began after the '90s, when the World Bank demanded, being actively involved in this economic field [2].

After 1989 the energy sector has been intensely supported by the state through a big budgetary effort, the state spending large amounts of money through grants, transfers and capital allowances. Unfortunately, budgetary funds were insufficient and because of keeping energetic coal selling price low there were registered operating losses at most of the mines [1].

The area covered in this paper is situated within the area of Baraolt city, from Bodoş village border and the plots to be wooded before expropriation have been taken by the former Baraolt forestry-Covasna forestry department.

Technical-economic indicators are presented in Table 1 [3].

Table 1 Technical-economic indicators

Indicator	Value
Total area under study	St = 16,61 ha
Actual area to be forested	Se = 16,61 ha
Hedge against grazing	LG = 2650 m
Time of deployment	T = 7 years

The aims of the works are:

- Reseating forested vegetation on the former open pit waste-dumps
- Improving climatic conditions
- Restoring ecological balance in the area by restoring the biodiversity
- Improving the local and general landscape.

The areas covered by the mining exploitation perimeter as well as those surrounding them that bear the “imprint” of exploitation in the open pit and that don’t require remodelling will undergo rehabilitation and greening so that they can reach agricultural yield at the level they had before being affected.

Bodoș open pit ecological rehabilitation works [3]

Production in the open pit ended in late April 2004 due to economic inefficiency, the main factor being the poor quality coal exploited; at the time of the closure, Bodoș open pit had debts of 45.057.973.544 lei.

Once production stopped, all machines and facilities in the open pit were removed and redeployed to Căpeni Colliery.

The technical project on closing and cleaning Bodoș open pit has been achieved through a number of works to ensure safety and stability of the area and at the same time greening of the area, restoring the areas occupied by the open pit and its external waste-dump to the agricultural and forestry chain [5].

Within the project a barrier lake was built, three spaces in the open pit were decommissioned, rehabilitating the access road that had served exclusively the open pit as well as the LEA power line that had supplied machines in the open pit. Stopping activity in the open pit coincided with stopping discharging water from its floor.

The lake that will store the waters will be north-east and south-west oriented. The barrier lake will be 295 m long at the water gloss level and will be 30 m wide at the bottom of it. The slope angle of the walls will be 12 degree.

Rock material resulting from excavation was necessary remodelling surface. To ensure stability, 20m wide of the west side of the shaped area as well as the 370m length will be covered with acacia. Reshaping the surface runs at the same time as the geometrization of the external waste-dump, the embankment and reshaping material used for this is the excess of earth from the waste-dump.

The reshaped surfaces of the open pit and the waste-dump will be wooded, which will re-establish the slopes and wooded areas destroyed by lignite exploitation.

The already existing waste-dump need backfilling works – excavation, fertilization and grassing. The excess rock is the material necessary for remodelling the area occupied by the open pit. Together with reshaping the sterile waste-dump an 80 m long supporting wall will be built on the eastern slope of the waste-dump.

The channels following the roads will be resized according to the maximum flow of the rain waters and will be clad with concrete tiles. Their total length will be 14.000 m, fig. 2 [4].



Fig.2. Channels collection

Reconstruction of the public road on the section which was used by Căpeni Colliery to transport coal from the open pit and machines and materials to the open pit throughout the active period, the total length of the road sector being 7,5km.

As a result of the intensive lignite exploitation and transport on the initial bridge, it collapsed therefore needing repetitive constructive interventions which failed to achieve their aim.

In the same location but oriented perpendicular on Baraolt stream a bridge has been built, taking into account: the opening of the stream in the established location, 20 m; the daily and annually flow of vehicles; gauge of vehicles; maximum tonnage of the biggest vehicle; fig. 3.



Fig.3. Sight on bridge

Baraolt riverbed rehabilitation will consist of: dredging riverbeds, changing Baraolt river course where the old bridge used to be. The total costs of

environmental rehabilitation of Bodoş open pit are 14.206.391.90 lei.

Closing and ecological activity on Sfântu Gheorghe open pit [4]

Ecological activity of the open pit requires maintaining the ecosystems formed by accumulations of water from Porumbele waste-dump area with flora and fauna and using the affected areas as place of leisure.

Partially filling of the former open pit and building a leisure lake of 27 ha are part of the project objectives. Partially discarding of Porumbele waste-dump is made by transporting a volume of 6.170.000 m³ of sterile in the open pit. Arranging and greening of the open pit involve three steps: step I: geometrization of open pit floor; step II: lake formation; step III: slope grassing and foresting. Geometrization of the open pit floor involves entrapping and conducting all water inflows, groundwater and surface water towards a central sump hole which will supply the lake, fig. 4.



Fig.4. Open pit aspects

These works consisted of entrapping the brooks in the western, north-western and southern areas by executing artesian bore in order to allow the geometrization of the open pit floor and backfill and water storage to shape the future lake.

Earthmoving and geometrization works of the open pit will be performed, followed by its backfill by arranging the final slopes of the future lake and its surroundings.

The works consisted of open pit floor backfill up to the established level for the bottom of the lake set for 550m and the slopes by transporting material from Porumbele waste-dump, spreading and tamping it at 95 tamping level [6].

The open pit slopes are designed at an angle of maximum 9° in order to ensure their stability. Backfilling of the floor and the slopes is made by depositing material in layers of 30 cm with their

leveling and compacting at a compacting level of 95%.

The lake is filled with water from Crişului Valley and a water intake will be made on Crişului Valley and an adduction which will supply the future lake at a 5m³/h rate. The discharge channel is underground, made of 1,400 mm diameter pre-stressed concrete pipes on the lake- Crişului Valley route on a 1,047m distance.

A technological road will be built to ensure lake maintenance and supervision after putting it into operation.

Grassing and foresting the slopes means laying topsoil extracted from the topsoil waste-dumps, 30 cm thick, on the open pit slopes from the level representing the future water gloss at a level of +560 to the open pit frame at a level of +570.

Arranging the southern flank will consist of surface reconfiguration so as not to carry large amounts of mining mass from Porumbele waste-dump but to reshape the southern flank slope by rock dislocation from the external side of the open pit and filling the gaps at the edge of the slope.

The excavation volume needed to bring the slope to a 90° angle from level +570 to level+ 560 is 249.903 m³ and the filling volume is 393.875 m³. The difference will be brought from the Porumbele Valley topsoil waste-dump.

An perimetric access road will be built at the southern border of the open pit on private lands, being 5m wide and having 5 m wide safety pillar to allow access to earthmoving machines, needed to arrange the southern flank and to store fertile soil and for owners to access the play areas, fig. 5 [4].



Fig.5. The road for perimetric access

The sterile waste-dump will fuel with mining mass the difference of material necessary to build the southern and south-eastern flanks.

The difference of sterile which will not be needed for this reconstruction but will remain inside the waste-dump will be spread evenly on the south-western versant of Porumbele Valley. After the geometrization of the Porumbele waste-dump,

the surface will be covered with topsoil from the topsoil deposit and after that it will be sowed, continuing work at the now running waste-dump.

After rearrangement, a 455,750 m² surface will be replaced in the economic chain. 67,900 m² of the surface will be covered with saplings.

Rearrangement of the southern flank was designed to run on a 269,783 m² surface. After being arranged and covered with vegetal soil, 50,272 m² will be issued to be used by the old owners.

Next, for a 209,711 m² surface, greening operations are set to run over three years. These operations will consist of fertilization of the land, sowing perennial grass and Orchard saplings.

Total costs of Sfântu Gheorghe open pit rehabilitation is 72,442,471.93 lei [6].

Conclusions

In accordance with the Environmental Law, when the open pits stop functioning there have been identified the following effects of the impact on the environment:

The decisive impact has been on the ground by completely modifying the ground morphology of the entire 106.6473 ha area. Besides direct influences soil has been affected by the emergence of phenomena of material flow in the slopes with a modified balance by stripping and mining activities.

Sterile deposits in the waste-dump have been made within parameters which gave a temporary stability.

Failing to follow the waste-dumping parameters has led to downstream sterile material spills in certain areas.

If in the exploitation area the vegetation was completely destroyed, in the surrounding area vegetation and fauna have been affected to a smaller extent by deposits of sediment, and as for the fauna by anthropical impact.

Emergence and development of the exploitation has led to social-economic changes in the area, which require a coherent professional reorientation programme once the exploitation activity has stopped, which consists of redistributing staff to Racoş Sud open pit.

As a result of thorough research on the analysis area in terms of geographical location, impact of

mining in Bodoş and Sfântu Gheorghe open pits on the area, economic, social and environmental factors, existing circumstances, in order to integrate relevant elements in the sustainable circuit of area development all the measures in the project will be applied and will be adapted where there are inconsistencies.

In order to eliminate lignite exploitation effects, prevent water storage and landslides, the areas affected by the open pit and the waste-dump will be reshaped.

Destination of areas after reshaping and cleaning: 18,064 m² for the barrier lake; the forested areas after reshaping make 79,673 m², the access road to the remodelled and cleaned areas of the open pit make 1,725 m².

On a 355,957 m² surface the former open pit as well as large eastern and western reshaped areas will be grassed.

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