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Assessment of post-mining damage

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Abstract. The article describes characteristic features of post-mining and mining activities. These includes drop basins, settling ponds with flotation tailings, mine water discharge into surface water, coal waste dumps and their thermic activities. In conclusion, the financial demands oi individual remediation and reclamation activities are quantified. The costs of land reclamation measures with respect to the subsequent use of the landscape are also calculated for the Ostrava-Karvina Coal District.

1. Introduction

Currently, a number of organizations worldwide are engaged in the assessment of damage arising during mining and mineral processing. In this paper, we describe the assessment of damage arising in connection with black coal mining in the Ostrava-Karvina Coal District. In the Czech Republic, the Ostrava-Karvina Coal District is an important producer of coal, with an annual production of 12 million tones.

Both the active and closed mines in the Ostrava-Karvina Coal District have negative impacts on the environment. The paper describes how the mining activities have contributed both to underground and surface damage, and enumerates the manifestations of mining and some related problems, such as manifestations of mining on the surface and underground, problems related to settling ponds with flotation tailings, coal waste dumps, mine water discharge into surface water and mine gas emissions[6].

To be specific, a more detailed attention will be paid to coal waste dumps. After the termination of mining it is necessary to take certain measures to bring the territory designated to storing waste rock and coal slurries into an acceptable state. This leads to a disturbed ecosystem representing considerable costs due to landscaping.

The success of the land reclamation measures is also influenced by the subsequent use of the exploited rock in dumps and coal sludge from the settling ponds. At present, the waste rock from mining may be used in the building industry. Coal slurries in their different forms are used as fuel.
The paper compares the costs of land reclamation with respect to the subsequent use of the landscape. It also discusses the legislation related to the assessment of post-mining damage.

2. Manifestation of mining on the surface and underground

Free underground space is created by underground mining. Surrounding rock fills this space and the rock decrease continues through the immediate roof to the surface then the subsidence trough is formed on the surface according to the worked out seam depth, the depth of deposit occurrence and other influences. Its extent corresponds to the worked out underground space. The largest decrease in the surface will be reflected at the center of the basin and at the edges of the basin. Depression surface is slower with increasing distance from the center of the basin. This situation is on the figure 1.

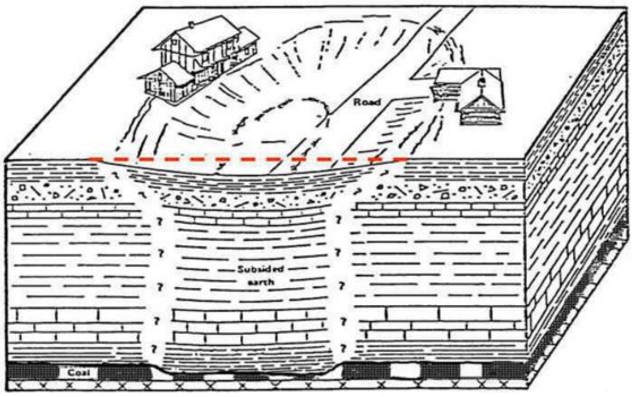

Figure 1. The scheme of the drop basin.

Figure 2. An example of the influence of undermining from the Karviná region [2].

The surface deformations in the Karvina and Orlova part of OKR can be demonstrated by figure 2, this is a so-called oblique church of St. Peter of Alcantara in Karvina-Doly. Church foundations has been deformed according to the shape of the subsidence trough and the whole building has been tilted. Mining technologies to minimize the impact of mining on the surface is chosen rarely in present time [3].

2.1. Settling ponds with flotation tailings

The coal slurries from coal preparation are a mixture of very fine particles of coal dispersed in water. Currently, coal slurries are not produced due to qualitative changes in mineral processing. Coal slurries in old settling ponds are currently used for other purposes or energy generation. The largest increase in slurry production occurred during the introduction of mining combines (when higher percentages of small dust particles were formed) in the late 1950s and 1960s. A dramatic decline in the production of coal slurries occurred in the 1990s in connections with the mining phase-out and the use of new technologies in slurry processing [1].

2.2. Mine water discharge into surface water

The water that has accumulated in underground mines all closed, was drained and pumped to drown low-lying active region after 1990 when the decline of mining. This condition should be achieved by maintaining the level of mine water Ostrava Mining Basin below about -388.5 m. This state is provided by special submersible pumps for central pumping of mine water on Jeremenko pit. The retention space of around 1.3 million cubic meters is formed in mines of Ostrava Mining Basin between height levels about -389.5 m and -371.5 m below the surface more.

The pumping and treating process of mining waters must be performed so that the discharge of surface water flow did not cause their contamination, and that represents a significant financial clause in billion CZK per year. Therefore, it would seem a good idea utilization of mine water temperature (about 26 °C) for such heat pumps.

2.3. Coal waste dumps

The catalogue from year 1989 presents that the former district of Ostrava has 116 waste dump disposal areas. At the Karvina district are located 143 of these and at Frýdek-Místek district there are 22 waste dump disposal areas. The condition of this areas is very various. Some waste dump disposal areas are still using for the waste dump storage and they hold their original character. The remaining areas are stabilized and partially reclaimed especially the waste dump disposal areas from the former mine activity. At some waste dump disposal areas got to the spontaneous combustion of a coal substance – the fire bank.

The thermic active Heřmanice waste dump ranks among the widest waste dump complex at the Ostrava Region, this is on the figure 3.

Figure 3. The thermic active Heřmanice waste dump [4].

Then next thermic active waste dump is The Ema Heap (figure 4), it is the unique technical monuments and it is the dominant feature of the Ostrava City.

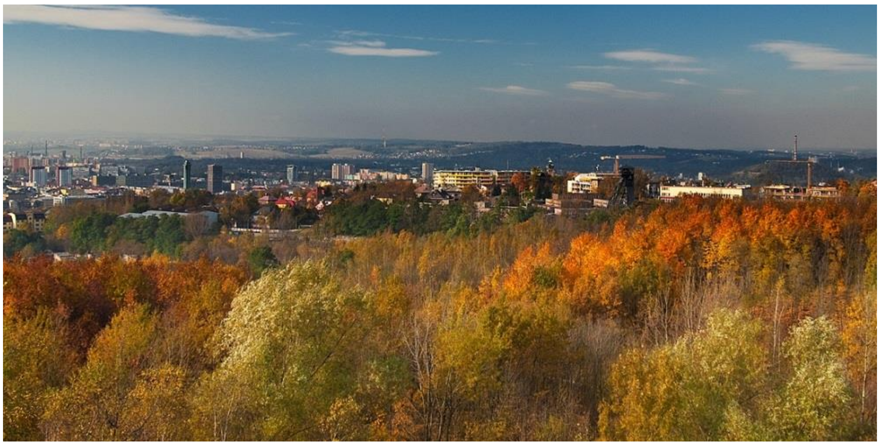

Figure 4. The view from the active waste dump – The Ema Heap [5].

2.4. Thermic process redevelopment method

The relatively common method of the redevelopment of waste dump thermic activity is grouting of inert materials. The inert material is forces in or gravity flow supplies into drill holes at the thermic active part of the waste dump. This inert material is the mixture of a flue ash and various materials. This method causes the free space sealing into the waste dump whereby some combustion gas is transmitted. This is not the single redevelopment method.

The cost overview of the waste dump forming and subsequent reclamation for one billion tones is in the table 1. There is introduced what expensive costs should be.

Table 1. The rough costs for a rock fill or a waste dump storage.

1	2	3	4
The low dumping costs (CZK)	A land buying up (CZK)	The waste dump storage costs (CZK)	The reclamation costs (CZK)
600 mil.	82.5 mil	100 mil	5.1 mil

2.4.1. Costs for individual redevelopment and reclamation actions.

The caused damages can be divide to five groups. At the figure 5 there are costs for individual action which this environment damages are fixed. The expensive costs for the river landscaping entail to consider if the mining profit will be sufficient for cover the costs.

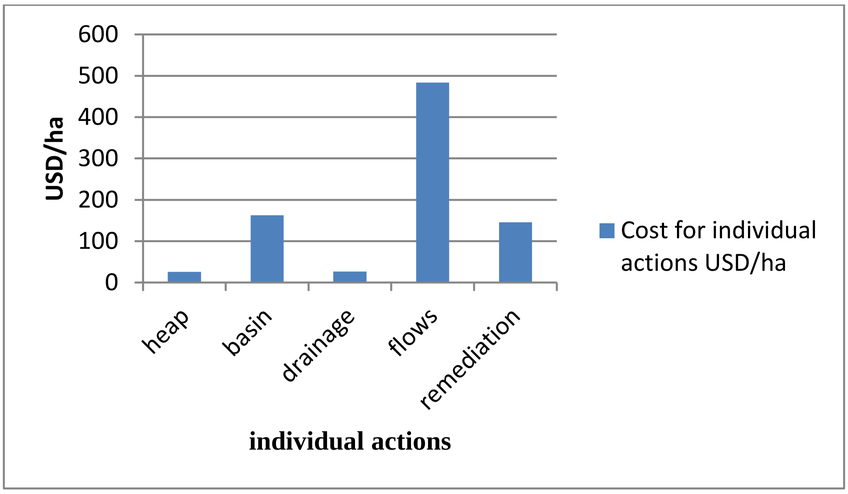

Figure 5. Costs for individual action USD/ha.

3. Conclusion

In the assessment of the damage caused by mining and treatment of minerals, the analysis in this article has been done, which is not self-serving. Ways to effectively remedy the damage was found and, if possible, exploit the economic value of the waste generated by the extraction and treatment of mineral resources.

The following analysis is based on this:

- Prior to mining, an economic and social analysis needs to be carried out in the area of interest. Conclusion is decision if the extraction or setting of the safety pillar is preferable.
- When closing mines and degassing boreholes, degassing and gas extraction for subsequent energy use must be used as much as possible.
- The using of the temperature of the mine water or the temperature of mine workings for the efficiency of the heat pump.

- In selected wasted dumps, there will be the technology of preparation plant or progressive sorting equipment to obtain valuable aggregate or coal using.
- For the decontamination and a recovery of sludge and settling tanks of coal sludge will make use the co-financing of municipalities, towns, regions, ministries (MIT, ME) and especially European funds.
- Obtain the European subsidies for projects that eliminate the impact of mining damages.

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References

[1] Trčková H 2015 *Analysis of damage on the environment by the extraction and management of mineral resources* (Ostrava: VŠB - TU Ostrava)
[2] Statutární město Karviná 2012 *Šikmý kostel sv. Petra z Alkantary – rarita v celém Česku*
[3] Hummel M, Hummelová I, Koudelková J and Černá K 2015 Mining of Protection Pillars without Subsidence *Inter.J. of Min. Sci. and Tech.* **5** 335-341
[4] Hylská M 2015 Rekultivace jižního plata odvalu Heřmanice
[5] HORNICKÝ KLUB 2009 *Aktivní odval Ema*
[6] Hudeček V, Urban P, Zapletal P and Košňovský V Elimination of safety risks at mined Coal faces in the Paskov mine Staříč plant – OKD, a.s. Czech Republic *Acta montanistica Slovaca* **18** 172-179