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Planning Long-Term Mine-Water Management for the Ibbenbüren Coal Basin

The anthracite deposit at Ibbenbüren has been exploited for 500 years. The special location of the mine on top of a hill demands specific consideration regarding the planning of maintenance and its long-term water management (i.e. dewatering) after the mine will have been flooded.

According to recent coal-related political decisions the subsidized production of hard coal in Germany will be terminated on 31st December 2018. The RAG group has provided the plan for ending coal production at the Ibbenbüren mine on this specific date.

The site's current annual production of high-quality anthracite coal is approximately 1.9 million tons. About 75 % of this production is used for the production of electricity in the adjacent coal-fired power station (Figure 1). The balance of the production is sold (without any subsidies) on the European heating and raw material market. At present the number of employees at RAG-Anthrazit-Ibbenbüren-GmbH is about 2,400.

The mine exploits a deposit in the form of a horst with no overburden rock. The ground surface, where the coal mine is located, is higher than its surrounding by more than a hundred metres. The top coal seams even reach the surface (Figure 2). Besides coal there is also an open-cast exploitation of carboniferous sandstone and clay stone in the Ibbenbüren region.

In hydrological terms this hill (i.e. the horst) functions as a joint water conductor and there is practically no production of drinking water inside this solid rock. The exploitation of Anthracite Coal took place in the western part of the concession as well as in its eastern part up till 1979. After the termination of production in the western part, this part of the mine was flooded finally in 1982. Since that time the mine-water has levelled out at the lowest overflow point which has been named "Dickenberg Day-Drift". Via this drift the water reaches the surface (Figure 3). Due to elevated concentrations of iron in the water it has to be clarified in the clarifying plant "Gravenhorst". The iron comes from the pyrite-oxidation of the rocks, which contain air above the subterranean water surface. The raw water currently has an iron concentration of 170 mg/l, and the sulphur concentration is 1.700 mg/l. The hydrochemistry of the mine-water has changed in a positive way during

Figure 1 / Ibbenbüren deposit.

the past 30 years. There is no reliable prognosis on how long iron-removal would remain necessary.

The end of the exploitation at Ibbenbüren (by the end of 2018) requires accurate planning of the on-going technical maintenance of the mine as well as a long-term water management plan. In view of the available time window, it is proposed to exclude the termination activities along with the durable save locks of the former used shafts (Figure 1).

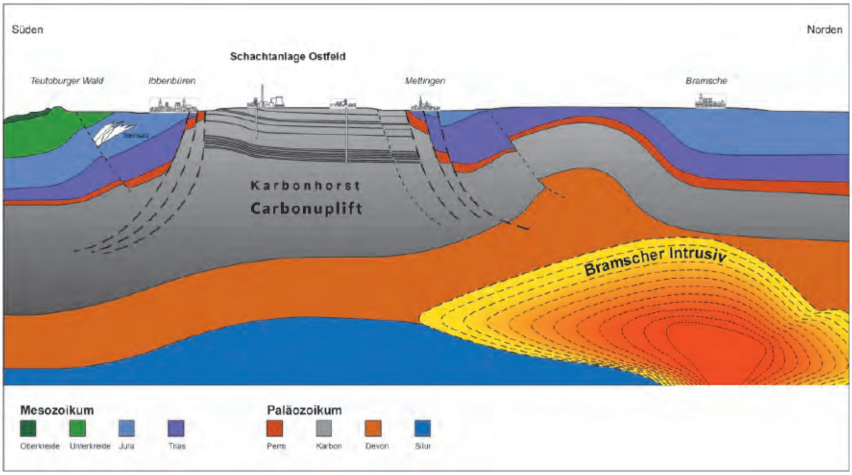

Figure 2 / Anthracite deposit Ibbenbüren (cross section).

Figure 3 / The Dickenberg Day Drift (portal).

The long term water management must be planned and prepared on the basis of several specific conditions with regard of the location of the site. The main aspects are:

- location of the site on top of a hill;
- isolated nature of the horst structure (resulting from the boundary faults);
- lack of overburden rocks;
- solid rocks/joint water conduction;
- closeness of exploitation to the surface;
- hydraulic gallery construction;
- former ore mining with an exploitation close to the surface;
- pyrite oxidation/iron and sulphate contents of the water;
- flooding of the Western part of the concession area; and
- flooding period of the Eastern part of the concession area.

The present situation consists of several, almost equal, levelled galleries in the Ibbenbüren area and the "Westfeld" the former flooded western part of the concession area. According to accumulated experience consideration also needs to be given to the joint-water of the flooded mine "Ostfeld" in terms of reducing iron concentrations. (Goerke-Mallet, Peter, 2000, Dissertation: Investigation concerning space significant developments in the Ibbenbüren area with a special attention to reciprocal effects of mining and hydrology, Verlag Mainz, 2000).

With regard to this starting position there are only a few possible locations for diverting the joint water from the underground structure of the mine. It has to be assured that the joint water will only be supplied after iron-removal from the drainage water has been carried out. In other words, the hydraulic active overflow facility has to be connected with the infrastructure used for removing the iron from the drainage water. Besides the technical aspects, basic legal water management regulations also demand special attention in this context.

The Dickenberg Day Drift forms the hydraulic active overflow facility in both the western and eastern parts of the concession area (Figure 5). This approximately 7 km long un-

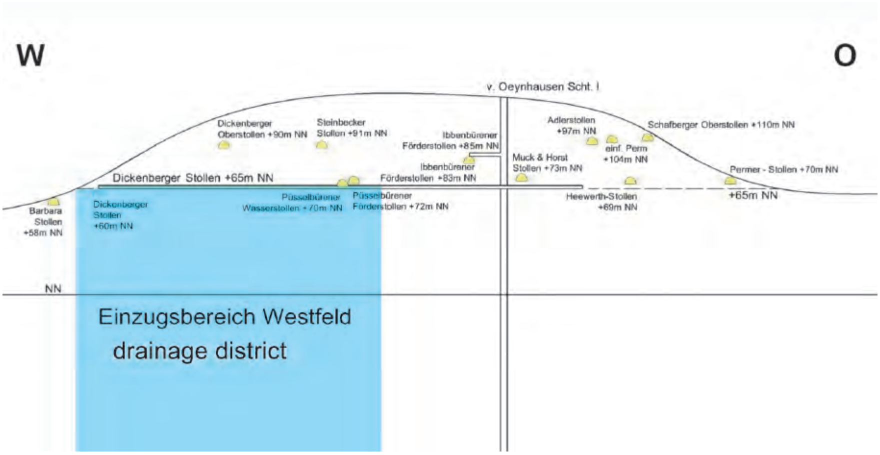

Figure 4 / Long term mine-water management „Ostfeld“ and „Westfeld“:hydraulic gallery construction (cross section).

derground plant was started in 1771 and in the 1st half of the 19th century the advance heading reached the underground plant of the eastern part of the concession area. It is unknown when this underground plant in the eastern part was inspected for the last time. Information about its stability, its section profile and its water management, has been gathered recently by spot drill checks and the use of a video camera.

However, the hydraulic output capacity of the Dickenberg Day Drift is still unknown. Similarly for the prognosis of the maximum joint water quantity arising in the eastern

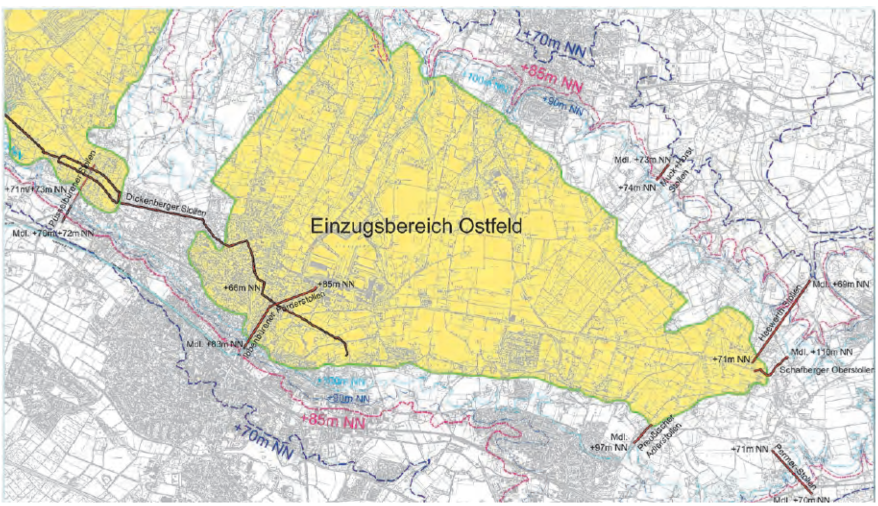

Figure 5 / Drainage district „Ostfeld.

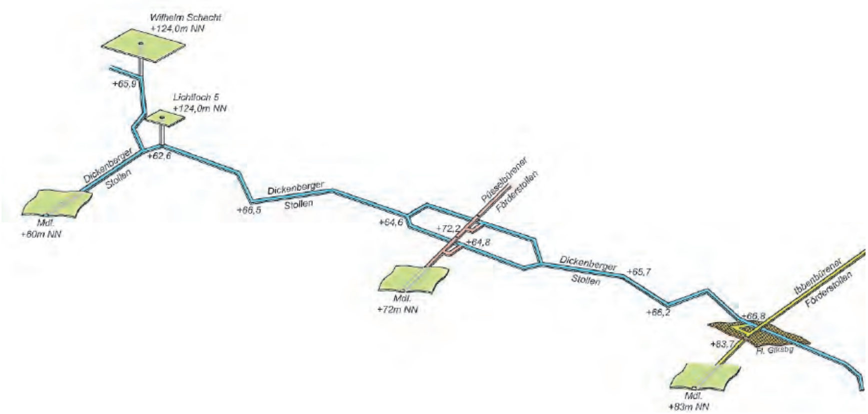

Figure 6 / Long term mining water management„Ostfeld“ and „Westfeld“, Dickenberg Day Drift (schematical graph).

part after heavy rainfall. In the already flooded western part the annual average quantity is about 7 m^3/min, with short-term peaks of 25 m^3/min.

If the inflowing joint waters of the eastern part should exceed the maximum drainage capacity of the Dickenberg Day Drift, then the standing water level will rise. In this case the joint water could block the Day Drift in the eastern part of the concession where drainage cannot take place. Therefore, the level of the standing water will have to be controllable by pumps, at least in case of a distinct elevated inflowing water quantity.

In order to assure this target, it will be necessary to keep the joint water level well below the level of the Dickenberg Day Drift, and to raise the waters to the same level as the Ibbenbüren mine adit (i.e. +82 m NN). Using a constant pumping rate the retention capacity of the mine layout would function as a buffer in case of high inflowing water rates. The diameter of the discharge pipe towards the iron-removal facility could be adapted and so the use of that facility could be optimised. In this case the legal aspects of water management, as well as the decrease of the mine adit which would be used for the long-term water management, could also be evaluated in a positive way. One disadvantage would be the cost burden for the permanent use of the pumps and the renunciation of the diversion of the joint water without pressure via the Dickenberg Day Drift.

The environmentally friendly maintenance of a mining site with a 500-year history of exploitation is neither trivial, nor unexciting. With regard to the restricted time and financial resources, the early conception of a long-term water management is essential, and this presentation outlines clearly the basic scenarios for addressing the complex task. Many system-related parameters can be fixed now, whilst others can only be dimensioned during the flooding process. The mine surveyor needs to be both a generalist as well as a specialist in the final phase of a mine and will undoubtedly meet significant challenges during the decommissioning process.

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