

Latest development in water management of Eastern-German lignite industry

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Abstract

About 25 years ago the lignite industry in Eastern Germany underwent major changes in conjunction with closing of many mines. In terms of water management rehabilitation this process has today enormous impact, in addition to the sharp rise in current requirements of environmental, water and mining law. In order for the various tasks can be mastered there was and still is the need for close cooperation between the active mining and remediation mining.

The tasks that have to be done here, refer to the creation of good quality rest lakes and their integration in the regional water balance and deal with minimization of impact from both active and abandoned mines to ground water and surface waters.

In the following article, the measures, tools and methods are described, which play an essential role in the water management of the East German lignite industry.

Key words: eastern German lignite industry, water management, water treatment, impact compensation

1. Introduction

Lignite mining in eastern Germany looks back on 200 years of history. It was and the extent of mining is steadily closely linked to the political and economic interests of the state and the governments.

Due to political changes in the late 80's of the 20th century in the former GDR the traditional lignite mining areas in eastern Germany (around Leipzig and in Lusatia) underwent major changes. While alone in the area around Leipzig 1989 20 mines had been operated, the number decreased to 11 until 1991 and in 1995 has been 3 mines left. The extraction rate was lowered from around 100 Mio. t in 1989 (ca. 300 Mio. t in whole eastern Germany) to 19 Mio. t (81 Mio. t) in 2015. Because in one fell swoop around 85 % of the mines were shut down the mining industry faced enormous challenges concerning mine reclamation and water management. As this could not be handled by the remaining mining operations, which itself had been in economic transformation, the reclamation and water management of mines shut down between 1989 and 1994 became state task.

Therefore today we still find the following structure in eastern German lignite industry:

- Vattenfall Europe Mining AG:
 - producing mines in Lusatian mining area (predominantly for power generation)
- MIBRAG mbH:
 - producing mines in Leipzig mining area (predominantly for power generation)
- ROMONTA GmbH:
 - producing mine in Leipzig mining area (predominantly for production of montan wax)
- LMBV mbH:
 - reclamation and water management of abandoned mines, shut down between 1989 and 1994, state owned

2. Water Management in Leipzig and Lusatian mining area

Particularly for water management of abandoned mines and with it for water management of the whole mining areas the close cooperation of producing mining companies and mines in reclamation is essential.

The close cooperation can be illustrated focusing on Leipzig Mining area. South of Leipzig MIBRAG operates the Vereinigtes-Schleenhain-mine and Profen-mine while LMBV is responsible for reclamation of 7 abandoned mines (Profen-Nord/Werben, Zwenkau, Cospuden, Espenhain, Witznitz, Bockwitz, Haselbach). The mines are located within an area of about 1.500 km². As all mines belong to the same catchment basin (Weiße Elsterbecken), there are numerous water related dependencies and interferences between the several mines.

Started to set up already in the 80's, after 1990 the overall hydrological model "HGMS", which covers the whole mining area and includes all important mining related and other boundaries, became the basis for all water related planning and operation. One of the most important aspects on this has been the analysis of technological variants of flooding the abandoned mines. As there river water was not available due to quantitative and qualitative reasons flooding the mines with water from dewatering works in producing mines turned out to be the best available alternative. A pipeline with a length of 65 km, which connects the producing with the abandoned mines was erected and is co-operated by LMBV and MIBRAG. From 1998 to 2015 about 500 Mio. m³ mine water had been pumped from coal producing mines to abandoned mines. Thus helped all partners, coal producer MIBRAG in water management, mine reclamer LMBV in realizing fast and cost-efficient mine reclamation and the region gaining reputation from new perspectives in economy, recreation and nature protection.

Today there are widely reclaimed landscape and coal production nearby.

Both earlier and much more today minimizing the engagement of lignite mining on the water balance is a mandatory requirement in order to be able to continue the operation of open pits in social consensus. Water protection and water treatment have top of the agenda – in Leipzig and in Lusatian mining area.

In the Leipzig mining area the progress in water related restoration resulted in reduction of pumping rate from operating mines to abandoned mines already in the last years and the rate will decrease further in future. Along with worse quality in mine water and higher legal requirements it was necessary to increase investments in water management in operated mines. These investments in Leipzig mining area relate to water treatment and impact compensation and are based on 2 points:

- Regular forecasts on mine dewatering and its impact
- Strategic planning for a sustainable provision of mine water for compensating measures during the complete mining period and during groundwater rise (f. e. well batteries, pipelines/pumping stations, local solutions) considering mine water treatment (Mine water treatment plants, natural attenuation)

So already in 2010 in Vereinigtes-Schleenhain-mine a mine water treatment plant (MWTP) was brought into operation with a deironising capacity of 60 m³/min. The iron content of the mine water of about 20-70 mg/l is reduced to less than 3 mg/l.

In the year 2017 another mine water treatment plant will be put into operation in Profen-mine. This MWTP will be able to handle mine water of about 120 m³/min, reducing iron content from 10-40 mg/l to less than 1,5 mg/l. A substantial portion of the total amount of water treated in this plant will be used for the most extensive compensating measures of MIBRAG (amongst a lot smaller measures) to equalize the influence of dewatering works of the Profen mine on Weiße Elster flood plain. About 25 m³/min will be brought separately to the river Weiße Elster upstream.

Facilities of the Lusatian mining area served as a model for the mine water treatment plants of MIBRAG. Due to different boundary conditions and local requirements Vattenfall continuously operated MWTP's

all the time in its operating mines. But also here investments in mine water management increased for several years – particularly with regard to compensating measures near the mines of Vattenfall.

For dewatering the Lusatian lignite mines in 2015 around 420 Mio. m³ mine water had been pumped. Dewatering here just like in Leipzig mining area occurs preferably using vertical filter wells.

With respect to geological conditions in Lusatia mine dewatering forms a large drawdown cone. Therefore Vattenfall tries increasingly to contain the groundwater lowering by constructing deep sealing walls. Due to the history of mining in Lusatia and due to the duration of dewatering measures the effects on groundwater are still significantly.

As a result of groundwater lowering a potential for conflict can arise, where is both the need for mine dewatering and on the other hand the requirement to maintain surface water and water use. In order to avoid the deterioration of condition of surface waters, also here compensating measures are necessary, such as supporting the river flow by discharging purified water in it (s. c. eco-water, water purified in MWTP which is used e. g. for waterbound ecosystems). Against this background the mine operator takes measures to water treatment, water supply and impact minimization. This measures usually focuses on the same points as in Leipzig mining area, supplemented by the following:

- Planning and construction of tie line for eco-water – impact compensation
- Planning and construction of sealing walls – impact minimization

21% of the pumped water is directly returned to bodies of surface water in order to be immediately distributed and to contribute to a stable water balance. This water is of good quality and without elevated ferric content. The remaining 79% is routed onwards to mine water treatment facilities (MWTP). This water is distributed onwards as follows; 48% is discharged into the Spree River and Neisse River, with a small share of this amount being discharged into the ecosystem; 31% is used in the lignite-fired power plants as cooling water and service water. This pit water is required to operate the power plants. 90% of the water used in the three power plants originates from the sump dewatering performed in the opencast mines.

Vattenfall Europe Ming AG operates six mine water treatment facilities (MWTP), while Vattenfall Europe Generation AG operates one such facility at the Jänschwalde power plant in order to treat and distribute the extracted pit water. Each year, these facilities retain 15.900t of iron, which is in the form of alkaline water containing ferric hydroxide with a solids ratio of 2%. In a facility located at the interior dump of the opencast mine Nohchten (Tzschenelln GWBA), the alkaline iron-hydroxide water (AEW) is dehydrated by a third-party enterprise not belonging to the Vattenfall corporation, the solid matter is then collected to manufacture iron granules serving water and flue gas purification purposes and put on the market.

The hydraulic barriers/ Sealing Walls Vattenfall has constructed are already taking effect in countering an exacerbation of the dewatering indicated problems. They are a unique differentiator of the mining region of Lusatia as compared to other mining regions. As a consequence of the hydraulic barriers, less water needs to be extracted, so that the region's water balance is impacted less and, what is likewise significant, less peripheral ferric oxide is laid dry. The hydraulic barriers are made of water-impermeable clay; at present, they can be installed down to a maximum depth of 110 to 150m. To date, VE-M has constructed approximately 25km of hydraulic barriers. A further 16km are in construction.

3. Conclusions

As stated previously, mine water management is one of the most important topics for eastern German lignite mining companies. Thereby the coexistence of old mining and mines in operation plays an important role for all water related planning, problems and problem solving. Water protection and water treatment have top of the agenda – in Leipzig and in Lusatian mining area.