Mine water as a resource - Innovative solutions and concepts for the mine water management in modern mining and mineral exploration

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Extended Abstract

World's mining each year disposes or discharges into surface water billions of cubic meters of water derived from dewatering of mine sites. In Poland, the water inflow to both open pit and underground mine sites amounts to around 3.5 – 3.6 mln m^3 per day. 90 % of these water is discharged into surface water. In terms of quality, c.a. 75% of mine inflow water, which is around 2.5 – 2.6 mln m^3 daily, is of low mineralization, allowing for its direct use in economy. KGHM Polish Copper – the biggest Polish ore metal mining company – pumps out from the rock mass around 26 million cubic meters of water annually, of which around 23 million cubic meters are discharged into Odra river (www.kghm.com). Due to qualitative parameters, very often this water might be used for further application in agriculture or for drinking water supply. However, vast amount of mine water is of low-quality, is highly mineralized and enriched in a number of components classified as impurity.

The main issue of modern mining, not only in Poland, is an inflexible and old-fashioned model of water management. In this model, after pumping the water into the surface and its partial usage in technological processes, the mine water is treated as sewage. After simple treatment processes it is directed to the sewage system or to the surface water. This action very often causes a significant change in river's ecosystems.

An innovative approach to the mine water management relies on comprehensive analysis of hydrogeological conditions and physico-chemical parameters of groundwater. These analyses should be conducted during the ore exploration and mine planning stages. Furthermore, the current monitoring of inflow water during exploitation is also indispensable. Accurate quantitative and qualitative recognition of water coming from particular water-bearing horizons allows on precise planning of the production as well as on proper prior planning of effective excessive mine water management, along with maximization of useful compounds recovery, application for the purpose of geothermal energy production or with usage in different branches of industry. It also makes forecasting of processes connected with mine closure possible.

KGHM Polish Copper for the past 60 years has been extracting the copper ore deposit in three underground mines: Lubin Mine, Rudna Mine and Polkowice-Sieroszowice Mine, located at Fore-Sudetic Monocline in the South-Western Poland. The depth of extraction is diversified and it varies from 400 meters in the South to 1200 meters in the North of the deposit. In the initial mining phase, which covered the shallower, southern part of the deposit, the mineralization of inflow water amounted to 350 – 500 mg/L, whereas now it amounts to 1 g/L. After the pumping out from the mine, the water was almost entirely used in technological cycle, and its excessive amount was placed into water pond at tailings facility. After the clarification, the water was directed into Odra river. Currently, the inflow intensity in the southern area oscillates around 15-30 m^3 per minute, which constitutes to around 90% of the total inflow to all three mine sites. Over the years, the exploitation also covered the northern, deep parts of the deposit, where the inflow water is highly saline and mineralization amounts to 100-150 g/L. The inflow intensity in this area does not exceed 3 m^3 per minute and generates around 10% of inflow water volume. The waters derived from both areas are combined in the mine

dewatering system, and in the form of saline water are being put into technological circulation at processing plant, then to tailing facility and later on are re-directed to the Odra river.

The newest concepts based on detailed examinations of mine inflow water and drillhole tests of water from the foreland of excavated area assume flexibility and optimization of mine dewatering system by, among others, selective water discharge. Low-mineralized water are to be used in technological processes, maximizing the cycle amount in the closed circuit. The best quality water are the potential source for the crops watering and as fire reserve for the forestry, while during the wintertime it might be discharged directly into the surface water without deterioration of its quality. Furthermore, the concept assumes several other optional scenarios of brines application, that except of high mineralization are also characterized by high temperature value (30 – 40 Celsius degrees) and are enriched in many useful compounds (e.g. B, Li, Ba). Collected selectively underground might be a material for cosmetic industry and for health resorts, a source of geothermal energy and a by-product in the useful compounds recovery process and production of fertilizers for agricultural purposes. Furthermore, the concept assumes purification of as large amounts of mine water as possible, including technological water. After the process of mineral components recovery, placing the mine water into absorptive parts of rock-mass will be conducted. These actions will make significant reduction of discharge of impurities into Odra river possible. As a result, the minimization of environmental royalties caused by the discharge will occur.

Key words: innovative mine water management, useful compounds recovery, mine water reuse, circular economy