

Water management issues in an abandoned coal mine district (Torre del Bierzo, Spain)

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Extended Abstract

The Carboniferous basin of El Bierzo has been intensively exploited by underground mining since the 19th century, and although the extractive activity is currently very low, mine shafts, spoil heaps, coal washeries and other mining installations remain as a legatee of the historical mining activities in the district. From this coal mine district, the presented study is focused into the Torre del Bierzo Sector, where abandoned coal mines from nine different mining groups coexist and the underground works are expected to be interconnected.

In a geological context, the Torre del Bierzo Sector is located in the south branch of the Asturoccidental-Leonesa Zone. The most significant characteristics of this Sector are the great thickness of the Lower Paleozoic (Cambrian and Ordovician) and the almost absence of post-Devonian materials, with the exception of some Carboniferous areas (the own coal basin) and tertiary/quaternary materials. The original permeability of the paleozoic rocks is generally very low but it may be locally important in areas affected by fracturing of the suprayacent rocks (secondary permeability); then, in general, the infiltration rate through these materials cannot be considered as very relevant. The tertiary-quaternary materials constitute a permeable detrital aquifer having a low permeability in general, which can be variable according to the lithological composition; with the highest values corresponding to the more abundance of sands and conglomerates.

From an hydrogeological point of view, from a pre-mining stage with aquifers of small importance, the extractive operations induce a post-mining stage with aquifers of triple porosity (intergranular porosity, fractures and mine voids) which can be assimilated to a karstic carbonated aquifer; the fracturation of the coal beds suprayacent materials as a result of the mine operations, increases the original permeability of the rocks and provides the infiltration of the rain water. The pump cessation option gives to the flooding of the mine voids and the creation of an underground mine reservoir, and in consequence to the overflow of the mine waters by the lowest mine portal of the whole system or by permeable levels located at a lower topographic cote, where mine water will present variable flow and quality depending on the characteristics of the geological formations, the drained system and on the exploitation technology.

In order to know if the mine works from the different groups of the mine sector act as an whole hydraulic system drained to the surface waters by one of the shafts, and to have an estimation of the mine water flow, origin and continuity of the water flow over the time and chemical quality, a geological, hydrological, hydrochemical and hydrogeological study has been accomplished. The water contribution received by each one of the mining subsystems (resources) anyway the whole volume of water stored on the mine voids (reserves) have been estimated too. To know if potential interconnections which could to define one or more hydraulic systems that could be considered as underground mine reservoirs (ponds) or to consider only the potential water interconnections through low permeability massifs has been studied.

The water resources for each group have been calculated independently, considering the infiltration of effective rainfall –according to the permeability of outcrops in their drainage basin-, the infiltration from agricultural irrigation and the losses from watercourses into the mining works. This calculation has allowed estimating which groups are currently drained at the point of discharge, the average drainage flow of the system (40-50 l·s⁻¹) and the effective volume of the underground mining reservoir (10⁶ m³), which could be employed for mine water storage and water or geothermal use. This drainage is currently discharged into a small creek and high concentrations of Fe, Mn and sulphate are sometimes reached.

The hydrogeological definition of the system implies this discharge will remain permanently, with a flow variable upon the volume and intensity of infiltration. However, given that agricultural activity in the area has decreased significantly, it would be desirable to avoid irrigation and river losses by performing a bypass, waterproofed over the most heavily mined areas. This would reduce the supply of mine water and improve its quality, avoiding fluctuations in the level of filling of the reservoir.

The fact to maintain a centralized pumping on the mine operations in one of the groups and the mine water discharge which is actually at the lowest mine portal of the whole system in the district, point out that the whole of the underground mine works in the district are interconnected and that the receiving water is drained towards this mine portal as corresponding to an unique hydrologic system. An approximate estimation of the water resources for each one of the mine groups for a standard hydrological year has been calculated according to a methodology de-signed for the case having in mind the cartography and the geological sections find in the bibliography.

Key words: mine water, abandoned coal mine, mine water reservoir