

Underground Pumped Storage Hydropower using abandoned open pit mines: influence of groundwater seepage on the system efficiency

Estanislao Pujades¹, Sarah Bodeux¹, Philippe Orban¹, Alain Dassargues¹

¹University of Liege, Hydrogeology & Environmental Geology, Aquapole, ArGEnCo Dpt, Engineering Faculty, B52, 4000 Liege, Belgium

Pumped Storage Hydropower (PSH) plants can be used to manage the production of electrical energy according to the demand. These plants allow storing and generating electricity during low and high demand energy periods, respectively. Nevertheless, PSH plants require a determined topography because two reservoirs located at different heights are needed. At sites where PSH plants cannot be constructed due to topography requirements (flat regions), Underground Pumped Storage Hydropower (UPSH) plants can be used to adjust the electricity production. These plants consist in two reservoirs, the upper one is located at the surface (or at shallow depth) while the lower one is underground (or deeper). Abandoned open pit mines can be used as lower reservoirs but these are rarely isolated. As a consequence, UPSH plants will interact with surrounding aquifers exchanging groundwater. These exchanges will modify hydraulic head inside the underground reservoir affecting global efficiency of the UPSH plant.

The influence on the plant efficiency caused by the interaction between UPSH plants and aquifers will depend on the aquifer parameters, underground reservoir properties and pumping and injection characteristics. The alteration of the efficiency produced by the groundwater exchanges, which has not been previously considered, is now studied numerically. A set of numerical simulations are performed to establish in terms of efficiency the effects of groundwater exchanges and the optimum conditions to locate an UPSH plant.

References

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