Modelling Pit Lake Flooding After Mine Closure

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Abstract

Most of mining works, either on the surface or in the underground, demand continuous groundwater pumping in order to operate under dry conditions. Required pumping rates for dewatering the work area can range from few tens to several hundreds of m3/h, depending on the hydrogeological conditions (geology, climate…) and the mine geometry and situation. Such complexity is the reason why groundwater models are extensively used to design the dewatering of future mining works. When the mining activity stops, dewatering also stops and mining facilities begin to flood. Most of the underground works will become fully flooded in a short period of time. Open pits will also start flooding, quite quickly at the beginning but becoming slower as the water level in the pit lake rises. The rise of the surface of the lake decelerates due to the bigger evaporation of water (more lake surface involves more evaporation) and the decrease of the groundwater pressure gradient towards the lake. Both effects are induced precisely by the surface lake rise. Therefore, incorporate this lake-flooding phenomenon into a hydrogeological model requires handling a nonlinear problem. In this work, this lake-flooding phenomenon has been added inside a hydrogeological model (Figure 1) as a BC of prescribed water head level on the lake. This fixed head results from the relationships between the groundwater water inflow rate of the lake, the elevation of the spillway (max elevation of the pit lake), the volume of the lake in function of the height of the water column and some other parameters. All these relationships have been set up in a set of global ODE and DAE. This set of equations has been solved then fully coupled with the water mass conservation equation found in the Subsurface Flow Module. The resulting model is able to recreate under transient conditions the pit lake generation. It can take into account the direct evaporation on the lake or other surface water uptakes. The simulations predict the rise of the water into the pit lake in function of time, the maximum elevation of the lake, the flow rate of the creek that can appear when the lake becomes full and starts overflow. Results obtained show a good agreement with the current available data. Finally, this model allows also the infiltration of the water of the lake back into the aquifer if, for any reason, the groundwater heads decrease below the lake elevation. In many situations, outflow (to the lake) and inflow (into the aquifer) can occur in different parts of the lake domain simultaneously.

Figures used in the abstract

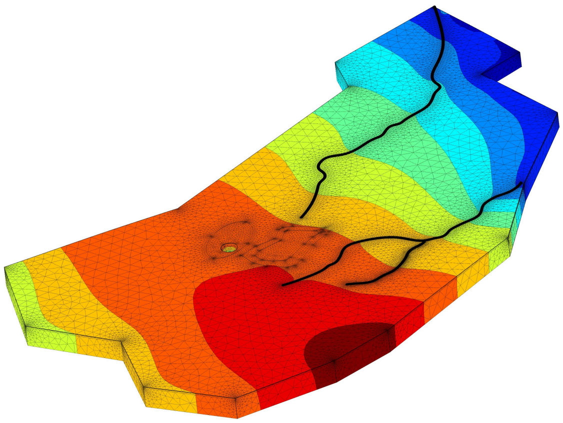

Figure 1: Head distribution in a 3D hydrogeological model with several geology strata, rivers and water recharge conditions.