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Management of Groundwater Pollution from a Decanting Mine: A Simulation/Optimization Approach with SCIP Algorithm

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Most of the major challenges facing groundwater management arise routinely from approaches aiming at ensuring water recourses sustainability, water quality protection and groundwater restoration. In many old mining sites, the most challenging practice is the management of contaminated water emanating from oxidising un-mined pyrites in the flooded abandoned mining shaft that decants into the natural environment. Pump and treat (PAT) is one of the commonly used techniques in management of groundwater pollution problem. Simulation-Optimization (S/O) models have proven to be very useful in appropriate design of an effective PAT remediation system. In this paper, simulation models MODFLOW and MT3DMS for groundwater flow and transport respectively, and a solving constraint integer problem optimization algorithm (SCIP) are employed in an effort to control pollution coming from a decanting mine. Simulation models predict the spatial and temporal variation of contaminant plumes with respect to remediation measures while SCIP optimization algorithm, on the other hand, is applied with an objective of minimizing the pumping rate while attaining a set of water lift and contaminant concentration constraints formulated. Results from this study indicated that the optimal pumping rate for the proposed pumping wells meet water quality and water lift requirements. Further, the obtained results demonstrate the application of SCIP in conjunction with simulation models as a capable tool in designing an effective groundwater remediation system. The performance of SCIP is also compared with genetic algorithm (GA) and the SCIP is found to have a better convergence rate than the GA.

Keywords: Groundwater, Management, Pollution, SCIP, S/O