World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:9, No:03, 2015

Optimum Dewatering Network Design Using Firefly Optimization Algorithm

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Abstract : Groundwater table close to the ground surface causes major problems in construction and mining operation. One of the methods to control groundwater in such cases is using pumping wells. These pumping wells remove excess water from the site project and lower the water table to a desirable value. Although the efficiency of this method is acceptable, it needs high expenses to apply. It means even small improvement in a design of pumping wells can lead to substantial cost savings. In order to minimize the total cost in the method of pumping wells, a simulation-optimization approach is applied. The proposed model integrates MODFLOW as the simulation model with Firefly as the optimization algorithm. In fact, MODFLOW computes the drawdown due to pumping in an aquifer and the Firefly algorithm defines the optimum value of design parameters which are numbers, pumping rates and layout of the designing wells. The developed Firefly-MODFLOW model is applied to minimize the cost of the dewatering project for the ancient mosque of Kerman city in Iran. Repetitive runs of the Firefly-MODFLOW model indicates that drilling two wells with the total rate of pumping 5503 m3/day is the result of the minimization problem. Results show that implementing the proposed solution leads to at least 1.5 m drawdown in the aquifer beneath mosque region. Also, the subsidence due to groundwater depletion is less than 80 mm. Sensitivity analyses indicate that desirable groundwater depletion has an enormous impact on total cost of the project. Besides, in a hypothetical aquifer decreasing the hydraulic conductivity contributes to decrease in total water extraction for dewatering.

Keywords : groundwater dewatering, pumping wells, simulation-optimization, MODFLOW, firefly algorithm
Conference Title : ICEWRE 2015 : International Conference on Environmental and Water Resources Engineering
Conference Location : Prague, Czechia
Conference Dates : March 23-24, 2015