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Case studies for utilizing groundwater-source and low-enthalpy geothermal resources in Korea

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As one of the top 10 oil-consuming countries in the world, Korea recently has had a great interest in extending the ways to utilize renewable energy. In this regard, geothermal energy resource is attracting more concerns from both of the government and the research field. Korea has neither active volcanic sites nor areas with abnormally higher heat flow. In spite of these natural conditions, many efforts have been exerted to utilize geothermal energy. Here, we introduce two case studies of using groundwater-source geothermal energy with relatively low-enthalpy: One is a riverbank filtration facility, which has been using some of its riverbank filtrate water for the indoor air-conditioning. The other is the first EGS plant planning site, where a few fault-related artesian wells reaching 70C were discovered lately. Numerical simulations to predict the temperature evolution of the two sites, which is dominated by several hydrogeologic factors, were carried out and compared.
Simulation of temperature profile of riverbank filtrate water using HydroGeoSphere shows that the primary factor in determining filtrate water temperature is the pumping rate. It also shows that maintaining the facility operation with present pumping rate for the next 30 years will not cause any significant change of water temperature. However, following the new plan of the facility to install additional 37 wells with 6 times higher pumping rate than the current rate might cause about 2C decrease in filtrate water temperature in 10 years after the extension.
Simulation for the temperature evolution in a faulted geothermal reservoir in EGS planning site under the supposed injection-extraction operating conditions were carried out using TOUGH2. A MINC model including a hydraulic discontinuity, which reflected the analysis from several geophysical explorations, was generated. Temperature distribution calculated from the simulation shows a rise of relatively hot geothermal water along the fault plane. It was proven out that in order to secure a stable operating efficiency of the plant, distance between the wells should be kept far enough so that the injected cold water can be warmed along the underground flow path. And after the installation of the wells, pumping/injection rates should be controlled carefully to adjust the underground fluid velocity in faulted geothermal reservoir and to avoid excessive drawdown.

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