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The performance of a borehole heat exchanger adapting thermally enhanced grout by thermal response tests

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We studied the performance of a borehole heat exchanger (BHE) adapting thermally enhanced grout by thermal response tests (TRTs). Recently the demand of the thermally enhanced grout for GSHP installation has been increased in South Korea but the researches are not well enough. This work is conducted by long-term thermal injection tests, temperature monitoring, and numerical analysis. The test site is located at Dangjin city, South Korea, and two sets of thermal injection test facilities including a borehole heat exchanger (BHE) and four monitoring boreholes, and a ground water monitoring well were used. Two kind of grout materials with different thermal property were used to compare the BHE performance as backfill material. One is thermally enhanced grout and the other is conventional bentonite grout, and the certified thermal conductivities from lab tests are 1.73 and 0.73 W/mK respectively. The BHEs and monitoring boreholes are 100m depth and initial ground temperature is about 15.0 °C. Long-term thermal injection of 10 kW during more than 11 days was conducted at each BHE and the data were interpreted by the line source model. According to the interpretation the thermal parameters of effective thermal conductivity and borehole thermal resistance were calculated in the range of 2.24 $\sim$ 2.70 W/mK and 0.11 $\sim$ 0.17 mk/W respectively. In the temperature changes at 50 m depth in the surrounding boreholes, it were shown a little more higher increase at the thermally enhanced grout type BHE than the case with the conventional grout. The thermal injection tests were compared with the numerical model by adapting the measured parameters and monitoring results. From the long-term thermal injection the temperature of the surrounding boreholes located for the distance 1.5 m from BHE are increased to 0.5 $\sim$ 3 °C and the increased temperature is higher at the thermally enhanced grout type BHE test. The economical benefit from the use of thermally enhanced grout were analysed by the calculation of total borehole length with several scenarios. This results provide some information for the adapting thermally enhanced grout at GSHP installation.
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