GHEtool calculation report

Course 7.4

24/08/26

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1.1 Structure of the report

First, in Chapter 2, a summary of all the simulations will be provided. In Chapter 3, the different simulation results are presented and discussed.

2.1 Scenario 1

Input

A TRT with a duration of 88,0 hour was performed on a borehole with diameter 152,00 mm and borehole length of 193,50 m. The average injection power was 9,63 kW and the initial, undisturbed ground temperature was 14,70 °C. The volumetric heat capacity of the ground was assumed to be 2,25 MJ/(m^3·K).

Results

The ground thermal conductivity was calculated to be 2,268 W/(m·K). The effective borehole thermal resistance during the TRT measurement was 0,062 m·K/W.

3.1 Scenario 1

In the first subsection, the scenario-specific input parameters will be discussed. Afterwards, the simulation results are presented.

3.1.1 Input

Thermal response test

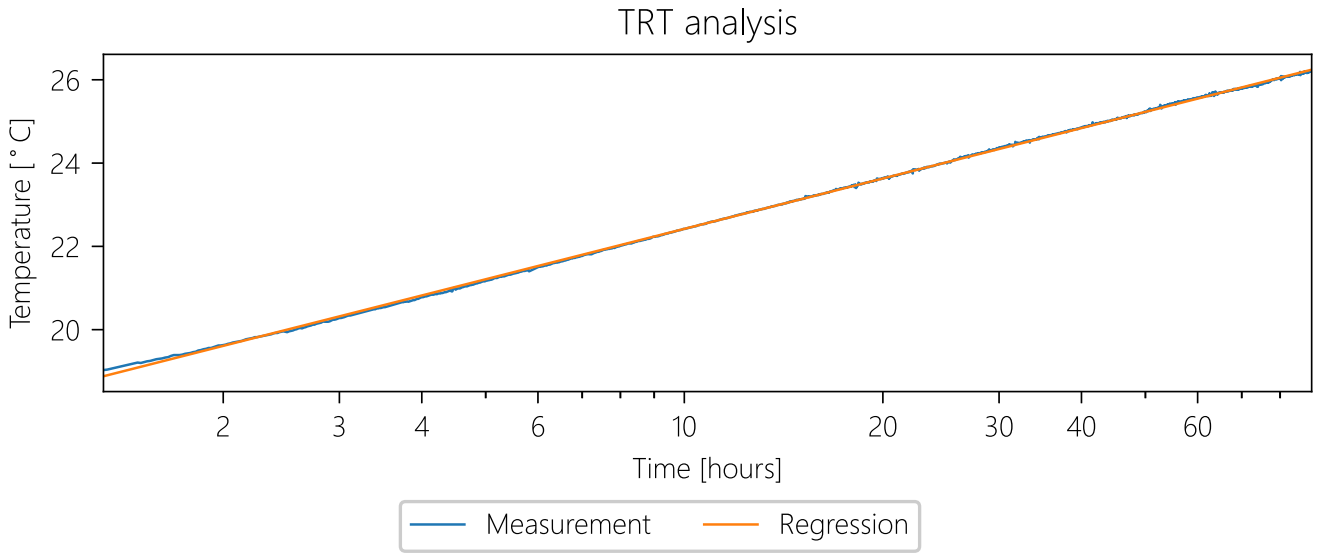
A TRT with a duration of 88,0 hour was performed on a borehole with diameter 152,00 mm and borehole length of 193,50 m. The average injection power was 9,63 kW and the initial, undisturbed ground temperature was 14,70 °C. The volumetric heat capacity of the ground was assumed to be 2,25 MJ/(m³·K).

3.1.2 Results

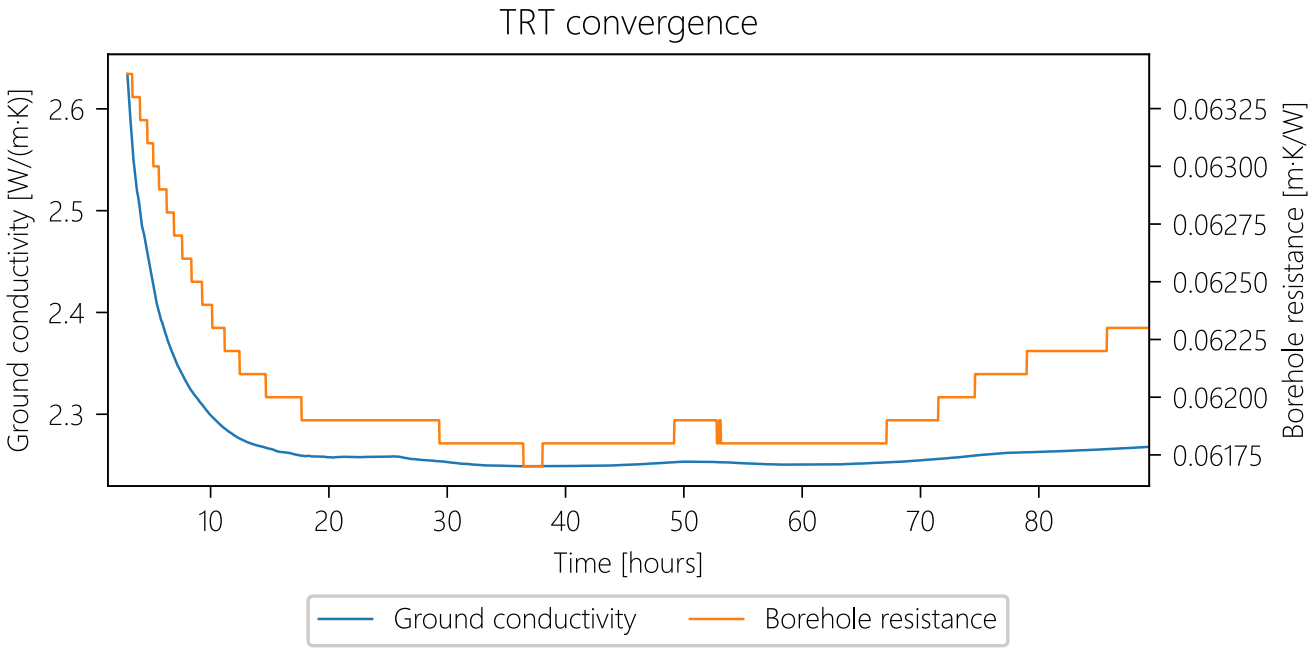
The analysis was done using the traditional infinite line source (ILS) model which was originally developed by Gehlin (2002). This method assumes that the borehole is an infinitely long line which interacts with an homogeneous ground. By plotting the average fluid temperature against the natural logarithm of the time (in seconds), a linear regression (at+b) can be found. These a and b coefficients can be used to calculate both the ground thermal conductivity and the effective borehole thermal resistance.

The ground thermal conductivity was calculated to be 2,268 W/(m·K). The effective borehole thermal resistance during the TRT measurement was 0,062 m·K/W.

The graph below shows the measurement data together with the linear regression, where a=1,745 °C/s and b=4,108 °C.



To assess whether the TRT has converged, the ground thermal conductivity and effective borehole thermal resistance are recalculated using progressively longer portions of the measurement data (e.g. the first 10 hours, 11 hours, and so on). Ideally, after a certain measurement duration, both the ground thermal conductivity and the borehole resistance remain nearly constant, indicating that the TRT has converged.


TRT convergence
Ground conductivity [W/(m·K)]
2.6
2.5
2.4
2.3
0.06325
0.06300
0.06275
0.06250
0.06225
0.06200
0.06175
Borehole resistance [m·K/W]
10
20
30
40
50
60
70
80
Time [hours]
Ground conductivity
Borehole resistance

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