



Thermal Conductivity Measuring Method for Water Filled Open Boreholes

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For designing of Ground Source Heating Systems (GSHS) Thermal Response Tests (TRT) are used for a long time. TRTs generally provide a profound basis for the final implementation of a GSHS. They obtain the effective thermal conductivity and thermal resistance of a borehole. Until today several TRT types have been introduced and defined as Geothermal Response Test (GRT), Enhanced GRT (EGRT), Constant Heat Flux TRT (chTRT), Constant temperature (ctTRT) etc.. These models mainly focus on closed heat exchangers in shallow boreholes. However, recent developments in medium depth drilling technologies make deeper boreholes more economic. Furthermore, advanced methodologies for obtaining thermal conductivities in deep and open boreholes are progressing. In this study, we introduce a new simple thermal conductivity obtaining methodology that can be used for deep and open boreholes.

Generally, TRTs are applied with the circulation of water inside pipes or immersing probes in water. In case of water circulation in deep boreholes, different heat flux values will be attributed to different layers. Moreover, by introducing a constant heat flux similar to conventional TRT into water-filled boreholes or water-filled pipes, convective movements of water will occur and thermal conductivities cannot be obtained. However, immersed probes as a heat source might prevent water convection cells inside a pipe or a borehole. In deep boreholes, the heat flux is depended on thermal conductivity of each layer. Thus, deep boreholes require a discrete heat introduction into every single layer of different thermal conductivity in order keep the temperature constant. The thermal conductivity of each layer can be approximated and integrated over the total length of a deep borehole. This effect is analytically and numerically investigated in this study.