

Efficiency and Design Aspects of Ground Heat Exchangers: A Parametric Analysis

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Shallow Geothermal Energy, a Renewable Energy Source, finds through Ground Heat Exchangers (GHEs) of various configurations (mainly vertical U-tubes, but also horizontal or spiral) that extract or reject heat from / into the ground. The sizing and consequently the cost of such systems (GHEs in conjunction with Ground Source Heat Pumps – GSHPs) depend on various factors. The objective here is to examine the factors affecting the sizing and positioning of GHEs in the Mediterranean environment of Cyprus. There is indeed a large number of parameters involved in the design of such systems, and the desired result can be achieved in various ways depending on the considered parameters. This is done through simulations by commercial design software programs (e.g. GLD) in combination with test data. The parametric study investigates the influence on the performance of GHEs of: (a) the temperature, (b) thermal conductivity, specific heat and density of the ground, (c) pipe diameter (of the GHE). Another important factor studied is the long-term temperature variation of the ground around the GHE boreholes, which affects the positioning of the GHEs. The main outcome of the parametric analysis is that – generally speaking – Cyprus constitutes a proper environment for the application of GSHP/GHE systems. The performance of the GSHP is not affected by the ambient conditions as the ground temperature remains unchanged.