ABSTRACT

Geothermal heat pumps use the ground to reject heat during summer operation or absorb heat in winter operation.

A lot of types of geothermal heat exchangers are developed. A common means of exchanging heat is through vertical ground heat exchanger that mainly consist of a descending and an ascending leg made of high density polyethylene (HDPE) pipe connected at their ends in the ground with a U-joint. A borehole with a diameter of 10 – 20cm and a common depth of 100 m is drilled in the ground, the heat exchanger is placed in position and the borehole is filled with thermally enhanced bentonite.

A borehole was drilled at Geroskipou region in Paphos in Cyprus. In that borehole, two U-tube geothermal heat exchangers made of high density polyethylene with 32mm and 25mm external diameter were installed. Hot water was circulated through the heat exchanger with a constant flow rate by a pump. Also, a heating coil with 3kW capacity was installed inside of an isolated tank in order to deliver the heat to the circulating fluid. Thermocouples were used for recording the temperatures of the water at the inlet and outlet of the heat exchanger. Also, a third thermocouple was placed into the ground at a depth of 1m of the ground surface and at distance of 0,4m of the centre of the borehole, for recording the soil temperature.

The proper evaluation of geothermal heat exchanger performance needs the knowledge of ground thermal properties. The target of this project was to estimate the mean thermal conductivity and the specific volumetric thermal capacity (the result of density multiplied by the specific heat) of the soil assuming the ground as uniform layer. By using the line source model (LSM), the thermal conductivity was estimated 1,45 and 1,34 W/(mK) for the experiment A (32mm external diameter) and B (25mm external diameter), accordingly. The volumetric specific heat of the soil was calculated equal to 5000000 J/(m^3K).

In addition, with the use of the FlexPDE software which is based on the finitive elements method the experiments were simulated and the results were compared with the experimental ones. For the simulation, the cylindrical heat source theory proposed by Carslaw and Jaeger was used. The results of the simulations were used for two

reasons: first of all, to confirm that the experimental results were verified by the cylindrical model and secondly, for studying the effect of some other parameters such as thermal conductivity, soil specific heat, coil capacity with out performing any experiments.