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# Optimization of High-Capacity Ground-Coupled Heat Exchanger under Hot-Wet Climate Condition: Numerical Approach

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## Extended Abstract

Ground coupled heat exchangers (GCHE) have received a significant attention during the past decades as a result of increasing the world's energy demand and the need for reducing fossil fuels consumption. Prior studies have demonstrated the effectiveness of utilizing GCHE with heat pump systems in cold weather conditions [1–3]. However, among other applications, GCHE could be used as a heat rejection method for chillers especially in hot and humid climates where cooling towers are not very effective such as the case of the USA Midwest and Gulf countries. In this work, ground borehole fitted with coaxial, tube within tube heat exchanger, referred to as (GCHE) is numerically simulated to solve the transient heat rejection to the ground. Based on a wide range of data collected about the ground conditions in Dubai, the soil thermophysical properties and water table conditions are characterized. The soil was divided into two distinct layers. A relatively small dry and porous upper layer, which operates in conduction mode and, a lower, water-saturated porous region that operates in coupled conduction-convection mode. The buoyancy-driven water flow in the soil coupled with Darcy model for the porous flow are developed. The study aimed at improving our understanding of the parameters advancing the heat rejection into the ground. Heat exchanger design parameters including pipes materials, diameters, lengths and thicknesses, inside insulation layer between the concentric pipes as well as the flow properties such as the water inlet and outlet temperatures and volume flowrates are investigated. The results indicated that the HDPE GCHE perform as good as the steel ones. Furthermore, flow configurations results indicated that flow direction alone has no significant effect on the HE performance. Furthermore, insulating the inner pipe resulted in 55% increase in the temperature duty of the heat exchanger. Finally, the results indicated a non-linear relationship between the working fluid flowrate and the produced temperature drop through the heat exchanger.

## References

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