Soil characteristic study to improve heat conductivity capability in ground heat exchanger

A. M. Aizzuddin, A. A. Asrudin, T. M. Yusof & W. H. Azmi
[a] College of Engineering, Universiti Malaysia Pahang (UMP), Lebuhraya Tun Razak, Pahang, Kuantan, Gambang, 26300, Malaysia

ABSTRACT
The use of vapor compression air conditioning has contributed to the global warming effect by increasing greenhouse gas emissions. Renewable energy from geothermal sources, specifically ground heat exchangers (GHE), has great potential in building applications. The underlying concept of pipe called GHE utilises the ground as an unlimited thermal reservoir for cooling and heating purposes. Because of the temperature differences between underground and surrounding air, the air in the underground cools in the summer and warms in the winter. Thermal conductivity of the ground or soil is among a parameter that contribute to the GHE's performance. Therefore, the purpose of this research is to investigate the effect of hybrid soils without moisture on the performance of the GHE system. The hybrid soils consist of two elements, which are native soil with three grain sizes and bentonite. The native soil grain sizes are 0.154–0355 mm, 0.355–0.6 mm, and 0.6–1 mm. Bentonite has been introduced into all native soil grain sizes, which ranges from 0 to 100%. The native soil and bentonite were mixed consistently, and the thermal conductivity was measured by using a thermal property analyzer device. The study shows that the grain size 0.6–1 mm of native soil has the highest thermal conductivity at 20% bentonite, which is 0.269 W/m K compared to other grain sizes. The performance of the GHE system was evaluated based on simulation of mathematical model which shows that pipe length of 16 m gives significant effect of temperature reduction. In short, the performance of GHE has increased once the thermal conductivity of hybrid soil increased.

KEYWORDS
GHE performance; Hybrid soil; Thermal conductivity; Bentonite

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