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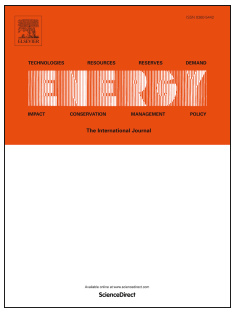

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A modified mathematical model for spiral coil-type horizontal ground heat exchangers

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ABSTRACT

Although many studies have investigated spiral coil-type horizontal ground heat exchangers (HGHEs), a reliable mathematical model of them has not yet been developed. Accordingly, this study proposes a modification of existing mathematical model, which was originally developed for energy piles and vertical ground heat exchangers, for HGHEs. Based on the solution of the heat equation using Green's function, the new mathematical model was derived by employing the mirror image method and superposition to consider the effect of a semi-infinite medium and ground temperature distribution. The prediction of the mathematical model showed a good fit with the results from on-site experiments with a mean absolute percentage error of 0.30 % and was perfectly matched with the numerical results. The proposed mathematical model is capable of capturing the structure of the spiral coil exactly, and consequently, it offers a more accurate prediction of ground temperature.

Keywords: spiral coil-type; horizontal ground heat exchanger; thermal response test; Green's function; numerical simulation

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