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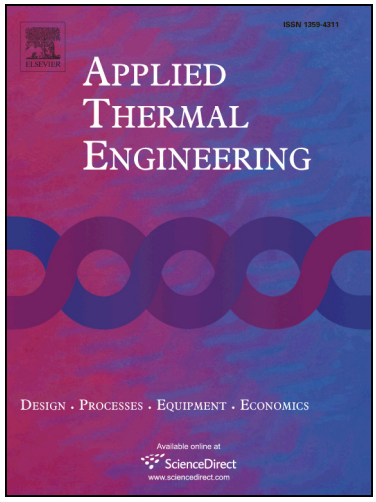

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A simplified method for evaluating thermal performance of unglazed transpired solar collectors under steady state

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Abstract: Due to the advantages of low investment and high energy efficiency, unglazed transpired solar collectors (UTC) have been widely used for heating in buildings. However, it is difficult for designers to quickly evaluate the thermal performance of UTC based on the conventional methods such as experiments and numerical simulations. Therefore, a simple and fast method to determine the thermal performance of UTC is indispensable. The objective of this work is to provide a simplified calculation method to easily evaluate the thermal performance of UTC under steady state. Different parameters are considered in the simplified method, including pitch, perforation diameter, solar radiation, solar absorptivity, approach velocity, ambient air temperature, absorber plate temperature, and so on. Based on existing design parameters and operating conditions, correlations for the absorber plate temperature and the heat exchange effectiveness are developed using dimensional analysis and data fitting, respectively. Results show that the proposed simplified method has a high accuracy and can be employed to evaluate the collector efficiency, the heat exchange effectiveness and the air temperature rise. The proposed method in this paper is beneficial to directly determine design parameters and operating status for UTC.

Keywords: Unglazed transpired collectors (UTC); Simplified method; Thermal performance; Absorber plate temperature

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