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Performance evaluation of a novel multi-pass solar air heating collector

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Abstract

In this present investigation, the performance of a new solar air heating collector of multi-pass mode is presented. The solar air heating system is theoretically modelled by applying energy balance expressions to reflect the network of convection and radiation heat flows. The theoretical analysis of the active air heater is supported by SIMSCAPE™ numerical tool while the proposed multi-pass solar collector system was tested under the meteorological condition of Seri Iskandar, Malaysia (4.385693° N and 100.979203° E). These techniques were used to audit the solar energy balance of the solar dryer system. The performance indices of the drying system were evaluated and the system thermodynamic correlations were obtained. Daily maximum temperature gradient between ambient and the system collector was 30.42°C. The thermal collector efficiency and optical efficiency were 59.96% and 72.26%, respectively. Improvement on system thermal delivery by the sensible porous matrix of 9.37% was achieved. The predicted performance level was compared with the test result and a relatively fair agreement was obtained. However, the instantaneous thermodynamic properties of air at the system boundary need to be defined to accomplish better accuracy on the relevant correlations.

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