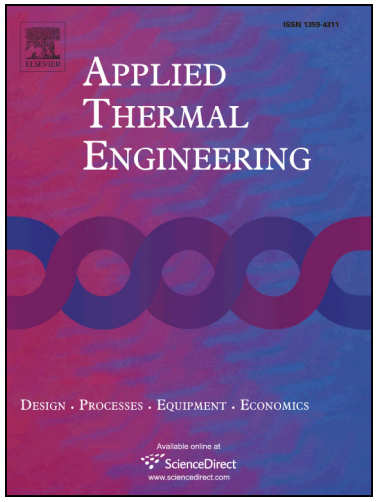

Research Paper

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Numerical analysis and experimental validation of heat transfer characteristic for flat-plate solar air collector

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Abstract

This study combines both concepts of solar ventilation technology and solar air collector. This is a quite innovative and potential facility to effectively use thermal energy and reduce the accumulation of heat in the indoor space simultaneously. The purpose of this study is to create a prototype and implement the experiments. Computational fluid dynamics (CFD) approach is employed to validate the characteristics of the flow and heat transfer. For the accuracy of numerical predictions, the method of Solar Ray Tracing was used for thermal radiation flux as boundary condition on the wall. The local heat transfer correlation was investigated to predict surrounding wind speed upon device cover. Three sorts of glasses and several aspect ratios of flow channels have been compared to conclude the optimal configuration. In addition, four important factors, such as the stagnant layer thickness, emissivity on the illustrated surface, mass flow rate and the height of the device, are also considered and discussed in detail. The result showed that the optimal design is dominated by the combination of an aspect ratio of 50 mm: 10 mm, and appropriate mass flow rate to the height of the device. The present work on thermal energy collection can assist us in designing a powerful solar air collector in some potential applications.