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Effect of thermal energy storage material on the performance of double-pass solar air heater with cross-matrix absorber

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Abstract

This study was to experimentally investigate the influence of thermal energy storage material inside the tube of a double-pass solar air heater with a cross-matrix absorber (DPSAH-CMA). The fabricated SAH was tested in both indoor and outdoor conditions under a variety of operating conditions. It was found that the DPSAH-CMA-with PCM achieve a better thermal buffer of-0.81 C/min as compared to the one without PCM at a mass flow rate of 0.005 kg/s. PCM contributed to the increment of obtainable cumulative heat rate for DPSAH-CMA-with PCM as compared to the one without PCM with a maximum value of 1548.54 W at higher solar radiation of 900 W/m². Storage efficiency of DPSAH-CMA-with PCM was maximum at a higher mass flow rate and directly proportional with solar radiation values. Performance comparison was conducted under the outdoor conditions in which the DPSAH-CMA-with PCM achieved higher thermal efficiency by 17% compared to DPSAH-CMA-without PCM. For the DPSAH-CMA-with PCM and without PCM, the exergy efficiency was 23% and 15%, respectively. The calculated cost-benefit ratio for DPSAH-CMA-with PCM was 0.17 RM/kWhr, which is 22% lower than the one without PCM.



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