Performance of force circulation cross-matrix absorber solar heater integrated with latent heat energy storage material

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Abstract

The utilization of thermal energy storage in the thermal absorber applications has been increasingly important especially in the application where there is a mismatch between energy demand and energy supply. This technology implies that the heat is stored during charging or discharging process through melting and freezing of the thermal energy storage material so that it can be used in the future. This paper presents the outcome of the experimental investigation on the performance of cross-matrix absorber (CMA) utilizing paraffin as the thermal energy storage material. Experiments were carried out by exposing the CMA under different artificial solar radiation (300 W/m(2), 500 W/m(2), 700 W/m(2) and 900 W/m(2)) for 30 minutes followed by 30 minutes of discharging process. Based on the observation, it was found that smaller mass flow rate value of 0.005 kg/s gave the highest temperature output regardless of the intensity of solar radiation as compared to the other after 30 minutes of charging process. In terms of heat gain by the thermal absorber, it was concluded that the highest mass flow rate of 0.01 kg/s passing through the absorber lead to the higher heat gain by the CMA, hence prolonged the cooling down /discharging period as shows by the result, where case with maximum mass flow rate (0.01 kg/s) consistently contributed to the higher heat gain by the absorber. This feature is very useful in the solar thermal collector related applications such as crop drying and domestic building heating. The heat gain by the absorber is also contributed by the intensity of the solar radiation.

Keywords

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1. **LOW-TEMPERATURE LATENT-HEAT THERMAL-ENERGY STORAGE - HEAT-STORAGE MATERIALS** Times Cited: 751
By: ABHAT, A
SOLAR ENERGY Volume: 30 Issue: 4 Pages: 313-332 Published: 1983

2. **Heat Transfer Enhancement for PCM Thermal Energy Storage in Triplex Tube Heat Exchanger** Times Cited: 10
By: Al-Abidi, Abduljalil; Mat, Sohif; Sopian, Kamaruzzaman; et al.
HEAT TRANSFER ENGINEERING Volume: 37 Issue: 7-8 Special Issue: SI Pages: 705-712 Published: MAY 23 2016

3. **Experimental investigation of the performance of a mixed-mode solar dryer with thermal energy storage** Times Cited: 12
By: Baniasadi, Ehsan; Ranjbar, Saeed; Boostanipour, Omid
RENEWABLE ENERGY Volume: 112 Pages: 143-150 Published: NOV 2017

4. **Performance of a new solar air heater with packed-bed latent storage energy for nocturnal use** Times Cited: 44
By: Bouadila, Salwa; Kooli, Sami; Lazaar, Mariem; et al.
APPLIED ENERGY Volume: 110 Pages: 267-275 Published: OCT 2013

5. **Energy and exergy analysis of a new solar air heater with latent storage energy** Times Cited: 34
By: Bouadila, Salwa; Lazaar, Mariem; Skouri, Safa; et al.
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 39 Issue: 27 Pages: 15266-15274 Published: SEP 12 2014

6. **Materials used as PCM in thermal energy storage in buildings: A review** Times Cited: 608
By: Cabeza, L. F.; Castell, A.; Barreneche, C.; et al.
RENEWABLE & SUSTAINABLE ENERGY REVIEWS Volume: 15 Issue: 3 Pages: 1675-1695 Published: APR 2011

7. **Review of Solar Thermal Storage Techniques and Associated Heat Transfer Technologies** Times Cited: 28
By: Cabeza, Luisa F.; Sole, Cristian; Castell, Albert; et al.
PROCEEDINGS OF THE IEEE Volume: 100 Issue: 2 Pages: 525-538 Published: FEB 2012

8. **Numerical and experimental investigation of a PCM-based thermal storage unit for solar air systems** Times Cited: 50
By: Charvat, Pavel; Klimes, Lubomir; Ostry, Milan
ENERGY AND BUILDINGS Volume: 68 Pages: 488-497 Part: A Published: JAN 2014

9. **Solar Engineering of Thermal Processes, 4th Edition** Times Cited: 759
By: Duffie, JA; Beckman, WA
SOLAR ENGINEERING OF THERMAL PROCESSES, 4TH EDITION Pages: 1-910 Published: 2013
Publisher: BLACKWELL SCIENCE PUBL, OSNEY MEAD, OXFORD OX2 0EL, ENGLAND

10. **The effect of using transverse fins on a double pass flow solar air heater using wire mesh as an absorber** Times Cited: 47
By: El-khawajah, M. F.; Aldabbagh, L. B. Y.; Egelioglu, F.
SOLAR ENERGY Volume: 85 Issue: 7 Pages: 1479-1487 Published: JUL 2011

11. **Performance of a natural circulation solar air heating system with phase change material energy storage**