

Accepted Manuscript

Title: Effect of direct evaporative cooling during the charging process of phase change material based storage system for building free cooling application—A real time experimental investigation

Authors: Karthik Panchabikesan, Antony Aroul Raj, Sujatha Abaranji, Pandiyarajan Vellaichamy, Velraj Ramalingam



PII: S0378-7788(16)31223-3
DOI: <http://dx.doi.org/doi:10.1016/j.enbuild.2017.07.037>
Reference: ENB 7777

To appear in: *ENB*

Received date: 17-10-2016
Revised date: 6-5-2017
Accepted date: 13-7-2017

Please cite this article as: Karthik Panchabikesan, Antony Aroul Raj, Sujatha Abaranji, Pandiyarajan Vellaichamy, Velraj Ramalingam, Effect of direct evaporative cooling during the charging process of phase change material based storage system for building free cooling application—A real time experimental investigation, Energy and Buildings <http://dx.doi.org/10.1016/j.enbuild.2017.07.037>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Effect of direct evaporative cooling during the charging process of phase change material based storage system for building free cooling application – A real time experimental investigation

Karthik Panchabikesan ^{a,*}, Antony Aroul Raj ^b, Sujatha Abaranji ^c, Pandiyarajan Vellaichamy ^a, Velraj Ramalingam ^a

^a *Institute for Energy Studies, Anna University, Chennai 600025*

^b *Easwari Engineering College, Chennai 600089*

^c *Thanthai Periyar Government Institute of Technology, Vellore 632002*

Highlights

- A novel hybrid concept integrating direct evaporative cooling and PCM based free cooling is proposed.
- Charging experiments are conducted under real ambient conditions in an Indian city that possess hot – dry climate.
- The hybrid system enhances the performance of the system in terms of charging duration and heat transfer rate.

Abstract

The adoption of phase change material (PCM) based free cooling technology in all the climatic conditions is challenging because of its site-specific nature. In order to support the implementation of free cooling concept in unfavorable climatic condition, a novel hybrid system with the combination of evaporative cooling and PCM based free cooling is proposed herewith. The present experimental work aims to compare and analyze the charging behavior of the PCM-based free cooling system without and with the integration of direct evaporative cooling (DEC) unit during the summer month (April) in an Indian city possessing hot - dry climate. By considering the local ambient conditions, PCM with a phase change temperature of 27–29°C is opted for the present study. The time-temperature history of PCM, instantaneous heat transfer rate, charging efficiency, heat exchange between the storage tank and ambient were analyzed and the respective results are presented. It is inferred from the experiments conducted without the integration of DEC unit that PCMs did not undergo phase transition and remained in the liquid phase even after 8 hours of the experimentation due to unfavorable local ambient conditions. However, in the case of experiments conducted with the integration of DEC unit, PCMs at all locations in the thermal energy storage (TES) tank got solidified irrespective of local ambient temperature and reached its freezing temperature. This is due to the reduction in heat transfer fluid (HTF) temperature and the additional temperature driving potential achieved through DEC. Better results in terms of charging duration was obtained for the experiments conducted with higher temperature driving potential than the higher HTF velocities. The main inference from the present study is that it is much possible to store the useful energy in PCM even during the summer season in the hot and dry

Download English Version:

<https://daneshyari.com/en/article/4918909>

Download Persian Version:

<https://daneshyari.com/article/4918909>

[Daneshyari.com](https://daneshyari.com)