Performance investigation of nanofluids as working fluid in a thermosyphon air preheater

Leong, K.Y.\textsuperscript{ab}, Saidur, R.\textsuperscript{b}, Mahlia, T.M.\textsuperscript{b}, Yau, Y.H.\textsuperscript{b}

\textsuperscript{a} Department of Mechanical Engineering, University of Malaya, 50603, Kuala Lumpur, Malaysia
\textsuperscript{b} Department of Mechanical Engineering, National Defense University of Malaysia, Sp, Best Camp, 57000, Kuala Lumpur, Malaysia

Abstract

In recent years, there has been a substantial increase in energy demand due to industrialization development. This raises concern on issues such as depletion of fossil based energy and emission of greenhouse gases. Hence, optimization of energy use through the thermosyphon air preheater is one of the possible approaches to address this problem. It can be used to recover and transmit the heat from the hot air (flue gas) to the cold air used for combustion process in a boiler. This study focuses on the analytical analysis of the thermal performance of a thermosyphon operated with water and nanofluids. The thermo physical properties of the selected nanofluids and relevant formulations are taken from the literatures to perform the analysis. Study found that change of nanofluid properties such as thermal conductivity only plays minor role in enhancing the thermal performance of the thermosyphon. The study implied that the hot air velocity is capable of increasing the efficiency of a thermosyphon. It is found that 23% overall heat transfer enhancement is observed when the hot air velocity increases from 2.0 m/s to 4.75 m/s for water based (7%) alumina and (4%) titanium dioxide nanofluids. © 2012 Elsevier Ltd.

Author keywords

Air-preheater; Heat exchanger; Nanofluids; Thermosyphon

Indexed Keywords

Analytical analysis; Cold air; Combustion process; Energy demands; Energy use; Heat Transfer enhancement; Hot air; Nanofluid; Nanofluids; Thermal Performance; Thermo-physical property; Thermosyphons; Water based; Working fluid

Engineering controlled terms: Air; Air preheaters; Alumina; Capillary flow; Energy management; Flue gases; Greenhouse gases; Heat exchanges; Mixed convection; Siphons; Thermal conductivity; Titanium dioxide

Engineering main heading: Nanofluids

References (25)

1. Abdelaziz, E.A., Saidur, R., Mehriif, S.
   A review on energy saving strategies in industrial sector
   doi: 10.1016/j.rser.2010.09.003

2. Saidur, R., Ahamed, J.U., Masjuki, H.H.

Cited by since 1996

This article has been cited 0 times in Scopus.

Inform me when this document is cited in Scopus:

Set alert | Set feed

Related documents

Showing the 2 most relevant related documents by all shared references:

Saidur, R., Leong, K.Y., Mohammad, H.A.
A review on applications and challenges of nanofluids (2011) Renewable and Sustainable Energy Reviews

Leong, K.Y., Saidur, R., Mehta, T.M.

Find more related documents in Scopus based on:

Authors | Keywords

More By These Authors

The authors of this article have a total of 303 records in Scopus:
(Showing 5 most recent)

Low, W.Y., Aziz, J.A., Hris, N.R., Saidur, R.
Electrical model to predict current-voltage behaviours of lithium ferro phosphate batteries using a transient response correction method (2013) Journal of Power Sources

Magnetohydrodynamic natural convection in

Add apps | Help
Energy, exergy and economic analysis of industrial boilers
View at publisher

Liu, D., Tang, G.-F., Zhao, F.-Y., Wang, H.-Q.
3 Modeling and experimental investigation of looped separate heat pipe as waste heat recovery facility
View at publisher

Murshed, S.M.S., Leong, K.C., Yang, C.
4 Enhanced thermal conductivity of TiO2 - Water based nanofluids
View at publisher

Murshed, S.M.S., Leong, K.C., Yang, C.
5 Investigations of thermal conductivity and viscosity of nanofluids
View at publisher

Rea, U., McKroll, T., Hu, L.-w., Buongiorno, J.
6 Laminar convective heat transfer and viscous pressure loss of alumina-water and zirconia-water nanofluids
View at publisher

He, Y., Men, Y., Zhao, Y., Lu, H., Ding, Y.
7 Numerical investigation into the convective heat transfer of TiO2 nanofluids flowing through a straight tube under the laminar flow conditions
View at publisher

8 Convective heat transfer characteristics of nanofluids under laminar and turbulent flow conditions
View at publisher

Duangthongsuk, W., Wongwises, S.
9 An experimental study on the heat transfer performance and pressure drop of TiO2-water nanofluids flowing under a turbulent flow regime
View at publisher

Shafahi, M., Bianco, V., Vafai, K., Manca, O.
10 An investigation of the thermal performance of cylindrical heat pipes using nanofluids
View at publisher

Do, K.H., Ha, H.J., Jang, S.P.
11 Thermal resistance of screen mesh wick heat pipes using the water-based Al2O3 nanofluids
Mousa, M.G.
12 Effect of nanofluid concentration on the performance of circular heat pipe
doi: 10.1016/j.asej.2011.03.003
View at publisher

Do, K.H., Jang, S.P.
13 Effect of nanofluids on the thermal performance of a flat micro heat pipe with a rectangular grooved wick
View at publisher

Qu, J., Wu, H.
14 Thermal performance comparison of oscillating heat pipes with SiO2/water and Al2O3/water nanofluids
doi: 10.1016/j.ijthermalsci.2011.04.004
View at publisher

Noie, S.H.
15 Investigation of thermal performance of an air-to-air thermosyphon heat exchanger using ε-NTU method
View at publisher

Incropera, F.P., Dewitt, D.P., Bergman, T.L., Lavine, A.S.
John Wiley & Sons (Asia), Singapore

Nuntaphan, A., Tiansuwan, J., Kiatsinirat, T.
17 Enhancement of heat transport in thermosyphon air preheater at high temperature with binary working fluid: A case study of TEG-water
doi: 10.1016/S1359-4311(01)00088-6
View at publisher

Mursheed, S.M.S., Leong, K.C., Yang, C.
18 A combined model for the effective thermal conductivity of nanofluids
View at publisher

Khanfar, K., Vafai, K.
19 A critical synthesis of thermophysical characteristics of nanofluids
View at publisher

Leong, K.Y., Saidur, R., Kazi, S.N., Mamun, A.H.
20 Performance investigation of an automotive car radiator operated with nanofluid-based coolants (nanofluid as a coolant in a radiator)
doi: 10.1016/j.applthermaleng.2010.07.019
View at publisher

Ijam, A., Saidur, R.
21 Nanofluid as a coolant for electronic devices (cooling of electronic devices)
doi: 10.1016/j.applthermaleng.2011.08.032
View at publisher

Hewitt, G.F., Shires, G.L., Bott, T.R.

CRC Press, Inc


23 Air heat exchangers with long heat pipes: Experiments and predictions
doi: 10.1016/j.applthermaleng.2007.03.004
View at publisher

Qu, J., Wu, H.-y., Cheng, P.

24 Thermal performance of an oscillating heat pipe with Al 2O 3-water nanofluids
doi: 10.1016/j.icheatmasstransfer.2009.10.001
View at publisher

Naphon, P., Assadamongkol, P., Borirak, T.

25 Experimental investigation of lithium nanofluids on the heat pipe thermal efficiency
doi: 10.1016/j.icheatmasstransfer.2008.07.010
View at publisher

Leong, K.Y.; Department of Mechanical Engineering, University of Malaya, 50603, Kuala Lumpur, Malaysia; email: leongkinyuen@gmail.com

© Copyright 2012 Elsevier B.V., All rights reserved.