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Thermophysical properties of Single Wall Carbon Nanotubes and its effect on exergy efficiency of a flat plate solar collector

Z. Said [a,b], R. Saidur [d,*], M.A. Sabiha [b], N.A. Rahim [c], M.R. Anisur [e]

[a] Department of Engineering Systems and Management (ESM), Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates
[b] Department of Mechanical Engineering, Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia
[c] UM Power Energy Dedicated Advanced Centre (UMPEDAC), Level 4, Wisma R&D, University of Malaya, 50603 Kuala Lumpur, Malaysia
[d] Centre of Research Excellence in Renewable Energy (CoRE-RE), King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, 31261, Saudi Arabia
[e] Department of Mechanical & Aerospace Engineering, Monash University, Clayton, Victoria, 3168, Australia

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Abstract

In order to enhance thermal efficiency of a flat plate solar collector, the effects of thermo-physical properties of short Single Wall Carbon Nanotubes (SWCNTs) suspended in water was investigated in this study. Sodium dodecyl sulphate was used as a dispersant for preparing a stable nanofluid. Subsequently, the nanofluid was comprehensively characterized by particle size measurement and spectroscopic technique. Specific heat with the increase of particle loading and temperature was investigated. Thermal conductivity increment also showed a linear dependence on particle concentration and temperature. Viscosity of the nanofluids and water reduced with the increase of temperature and increased with the particle loading. Using improved thermo-physical properties of the nanofluid, the maximum energy and exergy efficiency of flat plate collector was enhanced up to 95.12% and 26.25% compared to water which was 42.07% and 8.77%, respectively. This low exergy efficiency shows that flat plate collectors still require substantial enhancement. To the authors' knowledge, SWCNTs–H_2O was used as the functioning fluid for the first time to investigate both the thermos-physical properties as well as the increase in thermal efficiency of a flat plate solar collector.

Keywords: Specific heat; Thermal conductivity; Viscosity; Nanofluid; Exergy; SWCNTs

1. Introduction

Nanofluids are new addition to the family of fluids prepared by immersing nanoparticles in conventional fluids such as water, oils, ethylene glycol or coolants. In general, these nanoparticles used in nanofluids are metals, metal oxides or carbon nanotubes (CNTs), in diverse allotropic forms. Choi et al. (2001) first reported studies on nanofluids and also explored the potentials of these nanofluids, precisely in heat conduction applications. With regards to thermal engineering applications, enhancement of upto 60% in thermal conductivity for water based nanofluids was reported in literature (Keblinski et al., 2008; Yu et al., 2008).

One of the utmost extraordinary findings of the last decade are carbon nanotubes (CNTs) (Iijima and Ichihashi,

* Corresponding author at: Centre of Research Excellence in Renewable Energy (CoRE-RE), King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, 31261, Saudi Arabia. Tel.: +966 13 860 4628; fax: +966 13 860 7312.
E-mail addresses: saidur@kfupm.edu.sa, saidur912@yahoo.com (R. Saidur).

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