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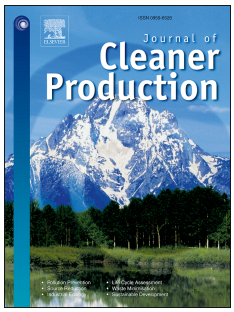

Performance analysis and optimization of an absorption chiller driven by nanofluid based solar flat plate collector

Evangelos Bellos, Christos Tzivanidis

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Evangelos Bellos, Christos Tzivanidis

Thermal Department, School of Mechanical Engineering, National Technical University of Athens, Zografou, Heroon Polytechniou 9, 15780 Athens, Greece.

Corresponding author: Evangelos Bellos (bellose@central.ntua.gr)

Tel: +30 210 772 2340 , Fax: +30 210 772 1260

Abstract

The objective of this paper is to investigate a solar cooling system with an absorption chiller driven by nanofluid based flat plate collectors. Pure water and water/Cu nanofluid (2% volumetric concentration) are the examined working fluids on the solar field and they are compared for steady-state conditions, as well as for daily operation. The system is optimized for steady-state conditions using a multi-objective procedure with energetic and exergetic criteria. The mean thermal efficiency enhancement by the use of nanofluids it is found close to 2.5%. The optimized system is further examined on a daily basis for operation with pure water and nanofluid. According to the final results, the use of nanofluids in the solar collector is able to enhance the exergetic performance of the system close to 4.0% and to increase the refrigeration production approximately 0.84% on a daily basis. The analysis is conducted with a developed model in Engineering Equation Solver.

Keywords

Nanofluid, Flat plate collector, Absorption chiller, Water/Cu, exergetic optimization

1. Introduction

The use of renewable and alternative energy sources is one of the most sustainable ways for facing the recent threads in our society as the climate change, the fossil fuel depletion, the increasing energy demand and the high cost of the electricity [Ebrahimi, 2017; Perea-Moreno et al. 2017; Esen and Yuksel, 2013]. Especially solar energy utilization is the most promising renewable energy source [Mehrpooya et al., 2016a; Mehrpooya and Moftakhari, 2017; Fotenis et al., 2018; Esen et al., 2017] because of its abundance and its capability to be converted either to thermal energy or to electricity [Said et al. 2016; Esen, 2004].

Solar cooling is one of the most attractive solar energy applications because of the high cooling loads in locations with high solar potential. Moreover, it is important to state that the building energy consumption is about the 30-40% of the total energy consumption in the majority of the countries [Tzivanidis et al., 2016]. More specifically, the building energy consumption fraction is 37% for Europe, 41% for the United States and 28% for China [Ma et al., 2017]. Moreover, the use of solar energy and renewable energy sources is necessary in order the recent directives to be applied