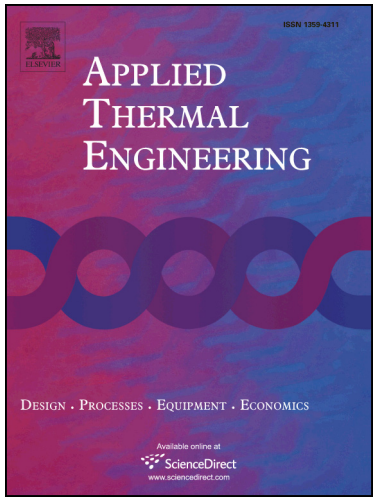

Research Paper

Experimental investigation and parametric analysis of a solar thermal dish collector with spiral absorber

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Experimental investigation and parametric analysis of a solar thermal dish collector with spiral absorber

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Abstract

Solar-tracking dish collectors are a potential alternative to fossil fuels because of their high concentration ratios. Important considerations for solar collectors are manufacturing costs, complexity, efficiency, uniform flux distribution and working fluid selection. In this study, a simple, low-cost solar dish collector with a spiral absorber and lightweight structure is examined. Experiments were performed with water as working fluid where the volumetric flow rate, inlet and outlet temperatures, ambient temperature, air velocity and solar irradiation were measured. Experimental results were used to validate a numerical model developed in Engineering Equation Solver, where three working fluids (water, thermal oil and air) were considered in various operating conditions. According to the thermal analysis, water is the most appropriate working fluid for low-temperature applications and thermal oil the most appropriate for higher-temperature applications. The exergetic analysis, however, shows that air is the most appropriate for low-temperature applications and thermal oil the most appropriate for higher-temperature applications. The highest exergetic efficiency was observed for thermal oil with inlet temperature of 155 ^{o}C. The system can be feasible in areas with solar potential of more than 1600 kWh/m^2 and where the cost of heating is more than 0.15 €/kWh.

Keywords

Dish, exergetic efficiency, solar collector, spiral, absorber

1. Introduction

Energy plays a pivotal role in our society because of new life trends which are accompanied with high energy consumption [1]. Moreover, there are many important problems related to the energy domain, such as increasing electricity demand, high CO_2 emissions, fossil fuel depletion and irrigation problems [2-7]. As an alternative to fossil fuels, renewable and alternative energy sources can be sustainable, cheap and abundant. Solar energy utilization is a key solution to energy problems, giving