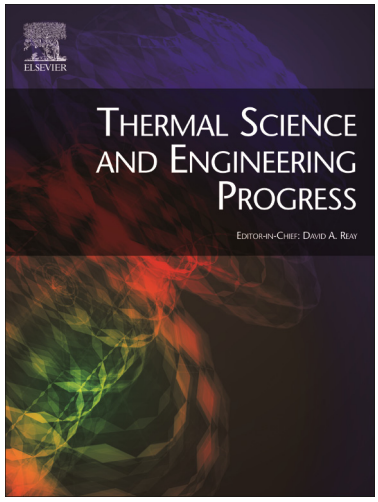

Investigation of a novel solar-driven refrigeration system with ejector

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Investigation of a novel solar-driven refrigeration system with ejector

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Abstract

The objective of this paper is the investigation of a novel solar-driven refrigeration system energetically and exergetically. The investigated system is driven by evacuated tube collectors and it includes the following devices: generator, turbine, ejector, evaporator, compressor, condenser, throttling valves and a gearbox. The examined system is compared with a conventional system without turbine, compressor and gearbox. In every case, the system is optimized in order to compare the optimum possible designs. Various working fluids are tested for both the systems and finally R141b is found to be the most appropriate choice. For the typical operation case with condenser temperature at 40^{o}C and evaporator temperature at 0^{o}C in steady-state conditions, the novel configuration has system coefficient of performance 0.1692 and the conventional system 0.06455, while the system exergy efficiency of the novel system is 1.664% and of the conventional system 0.6349%. Moreover, for the same operating scenario in dynamic conditions, it is found that the novel configuration presents the mean system coefficient of performance equal to 0.09157 while the conventional 0.02786. The results clearly indicate that the suggested system has higher performance than a conventional refrigeration system with an ejector device.

Keywords

Solar refrigeration, ejector, optimization, evacuated tube collector, exergy efficiency

1. Introduction

Solar energy utilization is vital for facing important energy problems as the fossil fuel depletion, the increasing energy demand, the global warming and the high electricity price [1-3]. Solar energy can be used in a great variety of applications as space-heating, cooling, refrigeration, industrial heat process, chemical process, desalination and electricity production [4-6]. Solar refrigeration systems are promising choices for covering the demand for refrigeration or cooling, especially in locations with high solar potential [7]. Moreover, the needs for cooling and refrigeration are generally higher in these locations the fact that creates great compatibility between source supply and load demand [8]. Furthermore, the use of solar driven refrigeration/cooling systems leads to a decrease in electricity consumption peaks, something beneficial for the total electricity grid [9].