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A low temperature flat plate solar collector

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Abstract

The performance of a low temperature solar collector, which acts as an evaporator of a heat pump system, has been investigated. An experimental setup has been designed, fabricated and tested under the meteorological conditions of Singapore. Refrigerant 134a has been used in the experiments. Effects of various parameters have been considered. Results show that, with the increase in collector tube length, the dryness fraction of the fluid increases leading to an increase in the heat transfer coefficient between the tube wall and fluid. Results also show that collector is very sensitive to solar radiation. If solar radiation increases, the mass flow rate of fluid inside the collector increases, which increases the collector efficiency as more heat is absorbed. Collector efficiency increases with irradiation, reaches a maximum and then decreases. Collector efficiency, as high as about 0.85 was obtained, which could be attributed to the low temperature operation of the collector.

Keywords: Low temperature solar collector, phase change working fluid, simulations, experiments, collector efficiency.

INTRODUCTION

In recent years, the demand for the fossil fuels has increased tremendously due to increase in population and development activities. The natural sources of fuel supply are likely to decline. These resources are considered essential for many applications, such as, industrial, transportation and domestic use. Therefore, attempts have been made for the use of the available natural energy sources, such as, solar energy, ocean thermal energy, geothermal energy, wind energy, etc. Several previous studies have considered the use of refrigerant as the collector fluid [1-8]. Chlorofluorocarbons (CFCs) were used as a refrigerant for all of their studies. Chlorofluorocarbons (CFCs) refrigerant, have harmful effects on the stratospheric ozone layer.

Therefore, a new refrigerant such as R-134a is used. R-134a has been used in this experiment, which shows zero ozone depletion potential (ODPj) [9]. In order to conserve energy, this project considers