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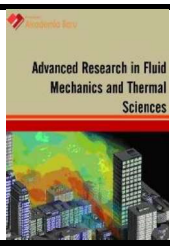

Design and Performance Testing of a Parabolic Trough Collector Including Deformation Test of the Receiver Tube

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ABSTRACT

Source of clean drinkable water is a big problem in the world. Water purification processes consume the fuel which extremely effect on environment, economy, and human health. Solar parabolic trough collector (PTC) was built to meet the requirement of drinking water for the village members in desert areas without relying on fossil fuel. The PTC powered by solar energy is the most favourable compared to flat plate because higher temperature is obtained. The design, fabrication, and performance medium-scale of a stainless steel solar-powered parabolic trough collector (PTC) with a 90° rim angle and 3 m×1.314 m aperture area as a hot water generating system were investigated in this paper. Theoretical calculations and primary design were achieved with all possible evaluations that provide accuracy design able to produce 200 L/day of water with more than 80℃. A certain amount of load equal to the force generated by 34 m/s wind blowing was applied to the PTC and deformed the parabola within acceptable limits. The gravity-load- and thermal-expansion-induced deformation of the receiver tube was also investigated. Comparing such deformation with the width of the solar image in the focal plane revealed a maximum deformation of 1.43 mm in the mid length of the receiver tube that was within acceptable limits. The deformation of the receiver tube is an important new test to assess the thermal performance of PTC. The performance of PTC was assessed based on the ASHRAE Standard 93. The reflected energy distribution of parabolic surface errors showed a standard deviation of 0.009165 rad, which, according to ASHRAE Standard 93, indicates that the parabolic surface has a high reliability. The collector time constant was set to 75 s, while the slope and intercept tests of the collector efficiency equation were 0.2358 and 0.72987, respectively. The experimental results show that the maximum water obtained from system is more than 226 L/day with temperature ≥50℃ at flow rate of 0.00925 kg/s, and at mentioned flow rate is 92℃.

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