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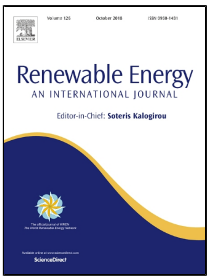

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Performance analysis of parabolic trough collectors with double glass envelope

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Abstract

In this work, the performance of Parabolic Trough Collectors (PTCs) with Double Glass Envelope (DGE) is studied. A two-dimensional model comprising optical and thermal analyses is developed. The effect of an Inner Glass Envelope (IGE), thermal emittance of the envelopes, and vacuum conditions in the two resulting annuli are analyzed in detail and compared with the performance of a traditional PTC. The incorporation of an additional envelope into a traditional PTC reduces heat losses. At high operating temperatures, the reduction in thermal losses achieved with the DGE PTC leads to a superior efficiency. It is found that an IGE having low emittance values could be used to reduce heat losses and replace the vacuum in conventional PTCs. In addition, in a DGE PTC, vacuum is more important in the annulus between the absorber pipe and the IGE. The effect of solar irradiance on the performance of a DGE PTC is also studied considering clear sky and partially cloudy sky day conditions. In general, higher solar irradiance values favor collectors' efficiency. Finally, the efficiency of a DGE PTC is analyzed considering a commercially architectural glass and a glass for solar applications. The DGE PTC with IGE made of a glass for solar application exhibits higher performance than a traditional PTC at high temperatures. However, a detailed economic analysis is required in order to determine the total energy cost with the proposed DGE PTC concept. Using a DGE improves the collector efficiency at high temperatures especially during partially cloudy sky days.