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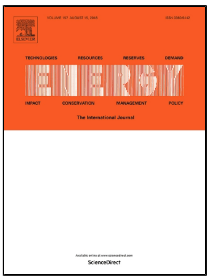

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Experimental performance of 300 kW_{th} prototype of parabolic trough collector with rotatable axis and irreversibility analysis

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Abstract

Parabolic trough collector (PTC) is the most mature concentrating solar thermal technology. Limited by the cosine effect, annual thermal efficiency of PTC is only 50 %. To show the limitations of performance of PTC and find corresponding solutions, an irreversibility analysis of PTC is experimentally conducted. Global exergy destruction is divided into exergy destructions in concentrator and receiver according to process analysis. Experimental results shows that the exergy destruction in concentrator accounts for the largest share. It indicates the process that sunlight being concentrated onto receiver is the key limitation of the performance of PTC. Experiments of the PTC with rotatable axis tracking show that rotatable axis tracking could decrease the exergy destruction in concentrator obviously. The annual exergy efficiency would be expected to be improved by 3 percent points according to the experimental results. This indicates that rotatable axis tracking is a practical method to improve the performance of PTCs. The influences of azimuth angle of PTC and heat transfer fluid temperature on exergy destruction are also analysed based on experimental data. In this study, the key limitation of the performance of the PTC is revealed and practical methods to decrease the exergy destruction of the PTC are provided.

Keywords: Parabolic trough collector; Experimental test; Rotatable axis tracking; Irreversibility analysis

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