

OPTICAL, THERMAL, AND EXERGETIC PERFORMANCE OF A NOVEL SPHERICAL SOLAR CONCENTRATOR WITH DIFFERENT CAVITY RECEIVER SHAPES

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Abstract

While a variety of solar concentrators have been studied for decades, the study of the spherical glass concentrator has never been reported, to the best of our knowledge. For that, this paper examines the optical characteristics of the novel solar spherical glass concentrator and identifies its performance and features. In addition, the thermal and exergetic performance of the concentrator are studied with three cavity receiver designs under various operating temperatures and different mass flow rates. More specifically, the examined receiver shapes: spiral, conical, and cylindrical. All the cavities are analyzed in order to determine the best design which maximizes the thermal efficiency of the solar collector. According to the results, the spherical collector can concentrate the heat flux up to 25 times the incident flux value. Also, the study is defined the best receiver dimensions that achieve optimum optical performance. Then, the optical analysis is conducted with an optical simulation in COMSOL Ray Optics to validate this work's findings. Moreover, the best design is found to be the one with a spiral shape, while the conical is the next choice. The cylindrical is the third design in the performance sequence.

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