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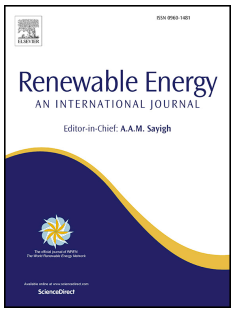

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Thermal analysis of porous volumetric receiver of concentrated solar dish and tower system

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Abstract

In this article, thermal analysis of Solar volumetric receiver used in concentrated solar thermal power systems is studied. A cylindrical volumetric receiver used in the parabolic dish collector and solar power tower is analyzed using a finite element method based tool COMSOL multiphysics software. A non uniform Gaussian distribution based heat influx is applied at the receiver to mimic the actual conditions.The steady state operation of the receiver is studied for various porosity and thermal conductivity of the solid phase. Different parameters of Gaussian distributions corresponding to different flux profile conditions are studied. The Gaussian profile heat flux amounting to $1MW/m^2$ results in the Gaussian like temperature distribution of the fluid phase near the receiver exit region. Higher thermal conductivity of $200W/(m.K)$ coupled with the high porosity of 0.7 leads to the better operational efficiency of the receiver. Lower porosity results in higher peak temperature in the fluid phase and higher thermal conductivity laterally spreads the temperature across the receiver. The intermittent solar flux condition is realized through transient response study of flux conditions. The temperature gain rate in transient case is found to be approximately 24 K/s while the temperature drop is around 29 K/s.

Keywords : Concentrating solar power; Surface volumetric receivers; Thermal optimization; Porous flow modeling; Gaussian flux analysis

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