Proceedings of CHT-15
ICHMT International Symposium on Advances in Computational Heat Transfer

May 25-29, 2015, Rutgers University, Piscataway, USA

CHT-15-094

Numerical simulation of a thermosyphon based hybrid solar-thermoelectric power generator

Xiaobing Zhang[*], Yogesh Jaluria[*] & Mona Zebarjadi[*]
[*]Mechanical Engineering Department, Rutgers University, Piscataway, NJ, USA

ABSTRACT Thermosyphons are one of the most efficient systems for transferring heat. We propose to use thermoelectric power generators as toping cycle incorporated in the thermosyphon heat pipe. The design uses thermoelectric power generators in parallel with the thermosyphon solar water-heating systems. A double-layer vacuumed glass shield is used to reduce the convective heat loss and a selective surface absorber is used to absorb the visible and short wave infrared solar radiation while preventing irradiation losses at the infrared range. The collected solar heat is then transferred through the phase change material and the copper pipe to the water and the thermoelectric legs. The heat flux is then used for water heating and generation of thermoelectric power. In this paper, a comprehensive CFD modelling for the proposed hybrid solar-thermoelectric power generator is presented. Using the numerical model, we optimize the length scales and the number of required thermoelectric legs to maximize the hybrid solar thermal efficiency. This study opens up a promising novel possibility: to convert the solar energy to useful thermal and electrical energy more efficiently.