World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:9, No:05, 2015

Experimental and Numerical Analysis of Built-In Thermoelectric Generator Modules with Elliptical Pin-Fin Heat Sink

Authors : J. Y Jang, C. Y. Tseng

Abstract : A three-dimensional numerical model of thermoelectric generator (TEG) modules attached to a large chimney plate is proposed and solved numerically using a control volume based finite difference formulation. The TEG module consists of a thermoelectric generator, an elliptical pin-fin heat sink, and a cold plate for water cooling. In the chimney, the temperature of flue gases is 450-650K. Therefore, the effects of convection and radiation heat transfer are considered. Although the TEG hot-side temperature and thus the electric power output can be increased by inserting an elliptical pin-fin heat sink into the chimney tunnel to increase the heat transfer area, the pin fin heat sink would cause extra pumping power at the same time. The main purpose of this study is to analyze the effects of geometrical parameters on the electric power output and chimney pressure drop characteristics. In addition, the effects of different operating conditions, including various inlet velocities (Vin = 1, 3, 5 m/s) and inlet temperatures (Tgas = 450, 550, 650K) are discussed in detail. The predicted numerical data for the power vs. current (P-I) curve are in good agreement (within 11%) with the experimental data.

Keywords : thermoelectric generator, waste heat recovery, pin-fin heat sink, experimental and numerical analysis
Conference Title : ICME 2015 : International Conference on Mechanical Engineering
Conference Location : Montreal, Canada
Conference Dates : May 11-12, 2015