

THERMODYNAMIC MODELLING OF THERMOELECTRIC GENERATOR SYSTEMS

S. C. Kaushik¹, S. Manikandan², Ranjana Hans²

¹Professor

Centre for Energy Studies

Indian Institute of Technology Delhi

Tel:+91-11-2659-1253/ E-mail: kaushik@ces.iitd.ac.in

²Research Scholars

Centre for Energy Studies

Indian Institute of Technology Delhi

Tel:+91-11-2659-6465/ E-mail: manikandan@ces.iitd.ac.in

Abstract

Second law analysis fetched significance in analysing thermal energy systems as it locates and quantifies the irreversibilities in the system. This paper analyses the thermoelectric generator systems through exergy analysis. Four thermodynamic models for thermoelectric generator considering internal and external irreversibilities were developed in the MATLAB Simulink environment with temperature dependent material properties and analysed with various operating temperatures. Analytical formulas for exergy efficiencies and irreversibilities in the thermoelectric generator for all thermodynamic models were derived. The result shows that the exergy efficiency of the thermoelectric generator is higher than the energy efficiency. For a typical operating condition in irreversible thermoelectric generator with 31 thermocouples and with T_H and T_C of 453K and 303K respectively, the maximum energy and exergy efficiency obtained are 4.23% and 12.78% at same optimum current of 7.02A. The result also shows that the effect of internal irreversibilities is more pronounced in the performance of thermoelectric generator system when compared with the external irreversibilities. The effects of irreversible heat transfer and contact resistance in the exergy efficiency is also studied. This study will be helpful in designing the actual thermoelectric generator systems.