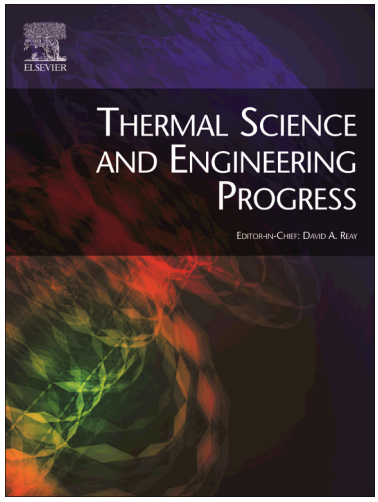

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Exergy and Exergo-economic analysis and optimization of a solar double pressure organic Rankine cycle

Milad Ashouri[1], Mohammad H. Ahmadi[2*],S.Mohsen Pourkiaei[1] , Fatemeh Razi Astaraei[1], Roghaye Ghasempour[1], Tingzhen Ming[3], javid Haj Hemati[1]

[1]*Department of Renewable Energies, Faculty of New Sciences and Technologies, University of Tehran, Tehran, Iran*

[2] *Faculty of Mechanical Engineering, Shahrood University of Technology, Shahrood, Iran*

[3]*School of Civil Engineering and Architecture, Wuhan University of Technology, Wuhan 430070, P.R.China*

Email address: mohammadhosein.ahmadi@gmail.com

Abstract:

This study presents an exergo-economic analysis and optimization of a double pressure organic Rankine cycle coupled with a solar collector via a thermal storage tank. Numerical analysis has been done to perform the exergetic analysis along with economic analysis. The performance of the system was examined during a day. Results showed that the system is capable of generating stable power during the day with a solar fraction of 100%. In nights and overcasts, the system can still generate power with the help of storage tank and an auxiliary heater. A parametric analysis examined the effect of key parameters on the system performance including exergy efficiency and product cost rate. The effective parameters included turbine inlet pressure and temperature. Exergo-economic criteria revealed that solar collector has the most value of $\dot{Z} + \dot{C}_D$ which is due to both high exergy destruction and high investment costs of the collector. Following the collector, the storage tank, condenser, turbine, recuperator and evaporators had the highest destruction. To perform the optimization process, two objective functions including exergy efficiency and product cost rate were considered. Ten decision variable including inlet temperature and pressure of the turbines, heat exchanger minimum temperature differences and the mass flow rate of solar collector and tank and pressure of condenser were chosen according to the parametric analysis. Also, with the aid of a reliable decision-making technique called TOPSIS method, the optimal point was selected among the Pareto frontier of the genetic algorithm. Results show that system can reach the efficiency of 22.7% and product cost rate of 2.66 million dollars per year.

Keywords: Exergo-economic; Organic Rankine Cycle; Solar collector; Optimization, decision making.