Exergy analysis and exergoeconomic optimization of a binary cycle system using a multi objective genetic algorithm

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Abstrak

The increasing demand for energy and the current environmental issues are motivating experts to develop appropriate technology to face both problems. The binary cycle system is a highly effective generating technology which can be applied in the utilization of small-scale geothermal energy by using a working fluid that has a lower boiling point than water. In this paper, a geothermal power plant binary cycle system model was tested by using waste brine at a temperature of 180oC at well pad 4 of the Dieng geothermal power plant. In the optimization procedure, total exergy destruction and total annual cost are chosen as the objective functions. Optimization is made by using a multi objective genetic algorithm. Based on the simulation, it is known that the exergy efficiency and economic value of the optimal binary cycle of the geothermal power plant system has optimum conditions at an evaporation temperature of 163.3oC, a brine temperature in the preheater outlet of 130oC, and a water cooling temperature at condenser outlet of 35.4oC. The working fluid pressure at pump outlet is 3859 kPa with the composition of the working fluid mixture being 86% R601 and 14% R744, resulting in turbine power of 119.8 kW, total exergy destruction of 742.4 kW, and a total annual cost of 36,723 US dollars. These results indicate that, by setting the above operating conditions, the system can achieve optimum efficiency, as indicated by the minimum values of both exergy destruction and total annual cost.