Energy and Exergy Analysis Concepts: Modelling of Olkaria II Geothermal Power Plant in Kenya

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Abstract

Condensers of geothermal power plants need to operate at low pressures to ensure optimal use of energy resources. To optimize the steam condensation process cooling water temperature is varied to determine the value that gives a higher condenser efficiency resulting in more power output. Cooling water temperature is dependent on the ambient temperature; therefore, in tropical countries like Kenya, high daytime temperatures affect negatively the cooling efficiency of the cooling towers. The high cooling water temperature increases condenser pressure and exergy loss thus lowering the power output. Our study focused on modelling the cooling system towards lowering the temperature of cooling water in which an absorption chiller was integrated into the system. The relevant energy and exergy balance, and efficiency equations for the Olkaria II (Kenya) geothermal power plant subsystem were derived. Codes were then developed from the mathematically derived equations and solved using the Engineering Equation Solver software. By varying the evaporator temperature for a constant refrigerant load temperature; changes in condenser efficiency and turbine output were recorded. Simulation results showed that through adoption of an absorption chiller as the secondary cooling system the exergy destroyed in the condenser and turbine decreased and an improved power output was observed. The observations were then translated to financial benefits which suggested an increase in annual cash flow. However, further analysis is necessary which should account for current investment costs on the absorption chiller and labour.

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