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Research Paper

Combination of a geothermal-driven double-flash cycle and a Kalina cycle to devise a polygeneration system: Environmental assessment and optimization

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Abstract

Geothermal systems have a low carbon footprint and are eco-friendly. Therefore, the present study lays bare the fact that the waste heat from a geothermal-driven double-flash cycle can be efficiently recovered by a Kalina cycle and a thermoelectric generator. The Kalina cycle, in turn, has heat loss that is recovered by an LiCl-H_2O absorption chiller and another thermoelectric generator. The favorable electricity is produced by the low-pressure turbine of the double-flash cycle. The output power of the high-pressure turbine of the double-flash cycle is consumed in an electrolysis unit to produce hydrogen, and the electricity generated by the Kalina cycle is responsible for freshwater production in a reverse osmosis system. The exergy efficiency and unit cost of the products of the system are obtained as 35.58% and 9.512 $\$\,GJ^{-1}$ at the optimal point, which are proper values regarding the production of hydrogen and freshwater in the system. In addition, the payback period of the system is 0.418years, which is an excellent value. The high economic performance of the system is rooted in the low unit cost of the products of the double-flash cycle, which makes it a suitable choice to be employed as the topping cycle of such polygeneration systems. Finally, sustainability index and CO_2 emission rate at the optimim point are equal to 1.552 and 6.27 tone/day, respectively.