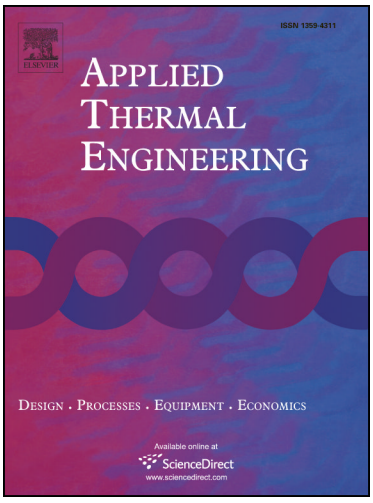

An efficient integrated trigeneration system for the production of dual temperature cooling and fresh water: thermoeconomic analysis and optimization

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An efficient integrated trigeneration system for the production of dual temperature cooling and fresh water: thermoeconomic analysis and optimization

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ABSTRACT

This paper describes and analyzes an integrated trigeneration system for the production of air conditioning, fresh water and refrigeration at different temperatures. A single effect steam driven H_2O-LiBr absorption cooling (ABC) cycle is integrated with a multi effect distillation (MED) unit and a CO_2 based parallel compression economization-vapor compression refrigeration (PCE-VCR) cycle. The thermo-economic analysis is performed to identify how the integration can improve the energy utilization and annual costs. A detailed parametric study of several key design and operating parameters and an economic optimization are also conducted. The analysis shows that the MED plant can produce a significant amount of fresh water using the free steam supplied by the ABC cycle. Changes in the number of effects, top and last effect brine temperatures, size of the VCR cycle and number of operating hours significantly impact the MED plant productivity and unit production cost of water (UPCW). The integrated ABC-MED-VCR system, in a base case analysis, reduces the unit production cost of cooling (UPCC) for combined cooling and refrigeration and the UPCW by 25% and 27%, respectively compared to separate use of the three systems. Due to integration, substantial improvements in the fuel energy utilization and reductions in the annual capital cost (ACC) and annual operating cost (AOC) are achieved. Also, the AOC and ACC decrease 38% and 13%, respectively. At the optimized conditions, utilization of exhaust waste gas to drive the integrated ABC-MED-VCR system leads to additional 52%, 41% and 0.13% reductions in the AOC, UPCC and UPCW, respectively.

Keywords: Integrated trigeneration system; Thermo-economic evaluation; Dual temperature cooling; Fresh water; Multi effect distillation; Air conditioning and Refrigeration.