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A novel bi-evaporator cooling system via integration of absorption refrigeration cycle for waste energy recovery from an ejector-expansion *trans*-critical CO_2 (EETRCC) cycle: Proposal and optimization with environmental considerations

Tao Hai [a b c], Masood Ashraf Ali [d] ✉, Hayder A. Dhahad [e], As'ad Alizadeh [f] ✉, Kamal Sharma [g], Sattam Fahad Almojil [h], Abdulaziz Ibrahim Almohana [h], Abdulrhman Fahmi Alali [h], El-Awady Attia [i] ✉

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Abstract

In this paper an integrated refrigeration system is designed, in which the waste heat from an ejector-expansion *trans*-critical CO_2 (EETRCC) cooling scheme is used for the generation of cooling not only above but also below the temperature of zero degrees Celsius. Waste heat usage was accomplished via employment of an absorption refrigeration system in conjunction with a CO_2 *trans*-critical refrigeration cycle. The absorption refrigeration cycle generates excess cooling above zero temperature utilizing the waste heat from ejector expansion system. Appropriate thermodynamic models are employed for feasibility assessment of integrated refrigeneration system, along with economic considerations to estimate produced cooling price. The results revealed significant better performance of novel integrated framework compared to standalone EETRCC cycle. In the best-case scenario, the levelized cost of cooling for the former is obtained as 105.3 $/GJ and, while the latter produces cooling with a levelized cost of 120.9 $/GJ. Also, it has been concluded that, when the temperature of the second evaporator is raised, the exergy efficiency of the system drops by 3 %, which results in increment of unit cost of the cooling by 6.34 %. In addition, highest exergy destructions are found to be 27.53 kW in the gas cooler and 15.57 kW in the generator.