

Four E Analysis and Multi-objective Optimization of an Ice Thermal Energy Storage for Air-conditioning Applications

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Abstract

One method to reduce the peak electrical demand of air-conditioning (A/C) systems is incorporating an ice thermal energy storage (ITES) with the A/C system. In this paper, an ITES system was modeled for A/C applications and analyzed from energy, exergy, economic, and environmental aspects (4E analysis). Applying the genetic algorithm optimization technique, multi-objective optimization of the system was performed and the optimum values of system design parameters were obtained. The exergy efficiency and total cost rate were considered as objective functions. The performance of modeled ITES system was also compared with a conventional system. The results indicated that electricity consumption in ITES system was 10.9% lower than that of the conventional one. Furthermore, 0.659×10^6 kg of CO₂ was prevented from emitting into the atmosphere in comparison with the conventional system. The extra capital cost associated with using ITES system was paid back with savings in electricity consumption in 3.39 years.

Keywords: Ice thermal energy storage system, Energy, Exergy, Economic, Environmental, Multi-objective optimization

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