Thermo-economic Optimization of an Ice Thermal Energy Storage System for Air-conditioning Applications

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Abstract

A major portion of electricity consumption in buildings in residential, administrative, and commercial sectors is related to air-conditioning (A/C) systems. To reduce and shift the electricity consumption of A/C systems from on-peak hours to off-peak hours, an ice thermal energy storage (ITES) can be utilized. In this paper, thermo-economic analysis of an ITES system was carried out for A/C applications. In order to consider the environmental aspects, a penalty cost was considered for CO_2 emission. Applying the genetic algorithm optimization technique, the optimum values of system design parameters were obtained. The objective function included the capital and operational costs as well as the penalty cost due to CO_2 emission, without and with costs associated with exergy destruction. The results indicated that, on average, the amount of electricity consumption and CO_2 emission of ITES system were lower 9% and 9.8%, respectively, in comparison with those of a conventional system. Furthermore, the ITES extra capital cost could be paid back through savings in electricity cost in 3.43 years.

Keywords: Ice thermal energy storage system, Air-conditioning, Thermo-economics, Environmental, Genetic algorithm, Optimization

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