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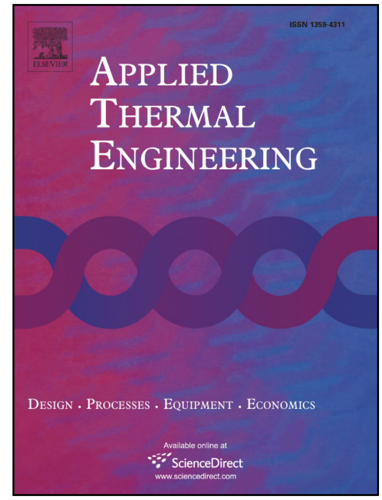

Research Paper

Design and retrofit optimization of the cellulose evaporative cooling pad systems at diverse climatic conditions

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Design and retrofit optimization of the cellulose evaporative cooling pad systems at diverse climatic conditions

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Abstract

Cellulose pad direct contact evaporative coolers (CPDECs) were modeled and optimized. In this regards, a detailed method for evaluation of the initial cost was introduced. This model was employed to minimize the life-cycle cost (LCC) and the annual water consumption (AWC) and maximize the annual average coefficient of performance (AACOP). It was assumed that the CPDEC was employed as the cooling system for a middle flat of a five-story residential building with floor area of 97.1 m^2. Multi-objective Optimization (MOO) imposing proper constraints, including thermal comfort was done in two scenarios: design optimization process (DOP, applicable before production) and retrofit optimization process (ROP, for currently manufactured systems). From the different groups within the Koppen-Geiger climate classification system, the ones in which the CPDEC had the potential of usage were identified; a sample city from each group was selected, and the features of the optimized systems for that condition were obtained. It was found that for all applicable climates in ROP as well as classes 'B' and 'C' in DOP, the optimum specific contact area was 540 $m^2.m^{-3}$. Moreover, the features of the optimized system in ROP were affected by both climatic and economic parameters while in DOP the effect of climatic condition was much more than economic criteria. The results also showed that in comparison to the base case conditions, MOOs improved, in average, LCC, AWC, and AACOP 52.8%, 74.3% and 146.9% in the case of DOP and 20.9%, 64.6% and 70.1% in the case of ROP. These mean significant improvements can be achieved by MOOs in the both scenarios.

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