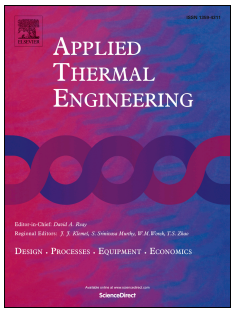
# Accepted Manuscript

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# Study of a Thermoelectric Space Cooling System Integrated with Phase Change Material

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## Abstract

A thermoelectric cooling system integrated with phase change material (PCM) has been proposed for space cooling purpose, in which PCM stores cold thermal energy at night and functions as a heat sink to reduce hot side temperature of thermoelectric modules during daytime cooling period and thus improve the performance efficiency of the system. A numerical model for the PCM-integrated thermoelectric cooling system has been developed to analyze the entire system under two working modes: (1) dissipating the generated heat directly to outdoor air through the air-water heat exchanger (mode 1) and (2) releasing heat to the shell-and-tube PCM heat storage unit (mode 2). Experimental tests showed the average system cooling COP is increased by 56% (from 0.5 to 0.78) because of PCM integration. With the experiment validated numerical modeling, a comprehensive guide of the design procedure for the PCM-integrated thermoelectric space cooling system has been introduced. The thermoelectric cooling system is designed, as a case study, for an office room located in Denver, Colorado, from which two conclusions have been made: (1) the cooling power output, COP and cost are the most important three factors that determine the selection of thermoelectric modules (TEM)