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Energy Efficiency Improvement of a Refrigerator Integrated With Phase Change Material-Based Condenser

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Abstract

Energy consumption of a household refrigerator majorly depends on the ambient temperature and is highest at the noontime and lowest at the night. To mitigate the impact of higher ambient temperature, condenser of the refrigerator is modified by incorporating phase change material (PCM) in it. This article presents the development of numerical model of the PCM-based condenser and its comparison with the experimental model. A 3D numerical model for a PCM, namely, FS21-based condenser has been developed in commercial software ansys fluent 16.2, and the simulation outcomes are compared with the experimental test results. A correlation of a coefficient of performance (COP) which is a function of PCM temperature has been proposed. Based on the developed numerical model and the correlation, two other PCM-based heat exchangers, RT25 and RT25HC, are also analyzed numerically and their PCM temperatures are predicted. At the end, COP of the refrigerator with each PCM is compared.

Keywords:

ambient temperature, COP, energy efficiency, household refrigerator, numerical modeling, phase change material material, energy conversion/systems, energy storage systems

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