Abstract

A bench-scale prototype was fabricated and tested as a proof of concept of the feasibility of using remote thermal energy storage in typical refrigeration applications. Water from an ice-water bath is pumped through a heat exchanger located inside a 1.35 cubic foot (0.038 m^3) refrigeration space to remove heat, and thereby creating an artificial cold space for food storage. With ice in a remote ice/water reservoir as the thermal energy storage medium, the air in the refrigeration space achieved a steady state temperature between 2 to 4ºC. It was determined experimentally that a minimum of 7.4 kg of ice is required to maintain this refrigeration space under 4ºC for 12 hours under conditions of a passive thermal load, experimentally determined to be 57.5 Watts. Preliminary tests of active and parasitic thermal loads were conducted by adding warm contents and opening the refrigerator door periodically. These loads were shown to be small compared to the passive load. Preliminary tests using an antifreeze demonstrated that temperatures below the freezing point of water could also be created using similar methods. The results demonstrate that the electricity usage of a refrigerator can be restricted to off-peak hours with the implementation of thermal energy storage. A wide scale implementation of household refrigerators with thermal energy storage can shift electricity production from peaking to base load plants and thereby increase the overall thermal efficiency of power generation and reduce the utility bills of consumers that select time-of-use pricing.