Abstract

A heat transfer model is developed to simulate the ice growth on a thermally long evaporator plate incorporated in an R134a vapor compression system. Ice blocks are grown alternatively with active and dormant period switching between two evaporator plates located on the bottom of a liquid reservoir. The ice generated is used as a thermal energy storage medium to maintain the temperature of a cold space during off-peak electricity hours while the compressor is inactive. An existing prototype was tested to help validate the model. The cooling capacity from this prototype was shown to be insufficient to maintain the temperature of a cold space of 1.35 cubic foot (0.038 m^3) while simultaneously producing significant thermal storage. Simulation results are consistent with that result and demonstrate that the amount of ice grown for a given period is constant with fixed difference between evaporating temperature of refrigerant and freezing point of coolant. The simulation results prove the feasibility of generating a large block of ice without releasing instead of small ice sheets with releasing on thermally long evaporator plates for thermal storage while maintaining a cold space suitable for refrigeration. The simulation model also shows the potential of creating a freezer space with thermal energy storage.