

Abstract

There is a need for an automated ice production system which operates in a continuous manner, for the improvement of existing products and development of new concepts. The design of an R134A based vapor-compression system incorporates two evaporator plates in direct contact with the bottom of a cold water reservoir. The actual performance of the system needed to be characterized through experimentation and compared with theoretical predictions. It was determined that the system is able to be operated in the range of evaporating pressures from 30 kPa,g to 120 kPa,g, corresponding to evaporating temperatures from -20°C to -6°C . For an evaporating pressure of 30 kPa,g the system demonstrates thermally long ice growth meaning that the refrigerant is completely evaporated prior to leaving the evaporator plate channels. However, at that pressure, the cycle time was limited to 10 minutes because the ice layers from the two plates merged for longer growth cycles. Results for evaporating pressures between about 80 kPa,g and 120 kPa,g showed thermally short ice growth, meaning that the refrigerant leaving the evaporator plate was not completely evaporated. For these evaporating pressures, a peak growth rate occurred for approximately 5 minute growth cycles and as longer cycles were run, a diminished growth rate of ice was observed. Hot gas bypass was necessary to facilitate ice release for all pressures tested for growth cycles less than 10 minutes. Beyond 20 minute growth cycles hot gas bypass was not needed to facilitate ice release. Consequently there is a tradeoff between the need for hot gas bypass to facilitate ice release and ice growth rate. Theoretical predictions of ice thickness showed excellent agreement with experiment.