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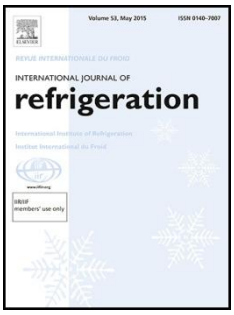

Title: Freezing time of a slab using the method of lines

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Freezing time of a slab using the method of lines

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Highlights

- A mathematical model has been developed to solve the heat conduction equation.
- The model simulates the freezing process for a slab.
- The mathematical model was solved using the method of lines.
- Various sets of properties were selected for the simulation of the freezing.
- The freezing time predicted agreed well with published experimental data.

Abstract

A one-dimensional mathematical model has been developed to solve the heat conduction equation and simulate the freezing process for a slab. The mathematical model was solved using finite differences and the method of lines (MOL).

In MOL, spatial derivatives are discretized by finite differences, and the resulting system in time is integrated using an appropriate solver. Several sets of thermal properties were selected to simulate the process. Predicted freezing time values were compared to 142 published experimental data sets. Predictions obtained by published numerical methods were compared to the experimental data. The freezing time predictions of the proposed model give a percentage error in the range of $-4.55 < E(\%) < 4.09$, which includes the 142 data sets using the best calculation results. In summary, the MOL is a good numerical prediction method since an adequate set of thermophysical properties is especially tested and selected for each data set.

Keywords: freezing; freezing time; method of lines; numerical method; thermal properties.

Nomenclature