Abstract

This thesis is mainly to study various melting processes starting from one dimension to two dimensions. The study was first to analyse the one dimensional melting process of ice slab and of porous materials with an application of a grid variation technique. This technique was used to solve for the melting front of material, In the two dimensional studies, the melting process due to a constant heat source, in particular conduction and heat circulation by convection in liquid zone. The melting process from microwave was also considered only the influence of conduction.

As of the only effect of conduction, the mathematical model of the melting process was simulated with the combination of heat equation and Stefan's equation. For the microwave melting process, the Maxwell's equation was included. This model was applied to the meting process that took place in both the unfrozen layer (liquid) and frozen layer (solid)., And in the case of heat circulation from convection in liquid zone, the mathematical model was a combination of heat equation, momentum equation, and Stefan's equation. The two-dimensional model was applied to study the process behavior in ice slab and saturated porous materials with moving boundary. To numerically solve the mathematical model for two dimensional moving boundary materials, transfinite interpolation method and PDE mapping method were used.

Temperature load and microwave frequency were important parameters of the melting process. Due to the effect of heat source (constant temperature or microwave) on melting rate, location of melting front, temperature distribution, the number of grid in the liquid zone was computed to be best suitable to predict this phenomenon. The calculated results were well in line with the analytical data.

In summary, this study yields useful fundamentals and the practical mathematical model for melting process in both one and two dimension. This will lead us to further study that involves various engineering applications such as materials forming process, ice melting process, food preservation process and tissue preservation process.