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On Mathematical Models and FVM Simulations for Convective/Solidification Industrial Processes*

Nelson Moraga†, Mauricio Godoy†, Carlos Garrido†,
Leopoldo Jauriat‡, Roberto Lemus† ‡

Abstract

Mathematical models and numerical results of unsteady temperature and velocity distributions, calculated using the Finite Volume Method, for liquid to solid phase change with natural convection are discussed. Typical cases found in industrial applications are presented for food freezing, ternary alloy solidification and binary alloy cylindrical solidification inside moulds. Problem 1 predicts either a solid food or a non-Newtonian liquid food freezing in air inside a freezer, with a conjugate natural convection/difusion or convective mathematical model. Problem 2 describes a ternary alloy solidification process in a square mould, using a porous model and a temperature dependent liquid fraction, in which the sequential solution of the discrete systems of unsteady, non-linear, coupled, partial differential equations is obtained with a new sequential algorithm, PSIMPLER. Problem 3 predicts the solidification of a binary alloy, Al-1.7wt%Si, in a cylindrical horizontal mould, based on a non–Newtonian power law model for the relation between shear stress and deformation rate, [1].

Key words: Finite Volume Method, PSIMPLER algorithm

References

[1] Moraga, N. O., Andrade, M., Vasco, D., *Unsteady conjugate mixed convection phase change of a power law non–Newtonian fluid in a square cavity.* International Journal of Heat and Mass Transfer, vol. 53, 3308–3318, (2010).

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†Departamento de Ingeniería Mecánica, Universidad de La Serena, Benavente 980 - La Serena - Chile. Tel: 051-204460 e-mail: nmoraga@userena.cl

‡Departamento de Ingeniería Mecánica - Universidad de Santiago de Chile, Av. Bdo. O'Higgins 3363 Santiago Chile.