A NUMERICAL SIMULATION OF CONVECTIVE FLOW IN THE SOLIDIFICATION PROCESS

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Abstract :

There has been a growing research interest in the melting and solidification technology among mathematicians and engineers. The topic has obvious practical importance in a wide range of applications. Natural convection may play a significant role in heat transfer and hence affect the progress of the solidification. A fixed-grid finite volume numerical approach is developed and used to simulate physical details of convection flow in the solidification problems. This approach is based on the enthalpy–porosity method that is traditionally used to track the motion of the liquid–solid front and to obtain the temperature distribution and the velocity profiles in the liquid phase. The enthalpy–porosity model treats the mushy region as a porous medium.

In this paper, the numerical and experimental studies of unsteady natural convection during solidification of cylindrical ingots are presented. The aim of the study consists of the numerical determination of the fluid flow, the temperature evolution, and the solidification front versus time. To validate the numerical model, an experimental study of the simple casting of cylindrical ingots was undertaken within the laboratory of metallurgy. The measured temperature was compared with values calculated numerically. A good agreement was obtained.

Keywords : Heat transfer; solidification; phase change; casts; finite volumes.

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