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Numerical Simulation of Heat Transfer during the Solidification of the Cylindrical Ingot of Zinc

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Abstract

In this work, experimental and numerical investigations were carried out to study the thermal transfer process during solidification of zinc. A direct calculation technical is presented for the study of the solidification problem in a cylinder following the two cylindrical coordinates (r and z) with a phase change in a transient regime. The axial and the surface temperatures are the result of a series of experimental measures carried out. The resolution of model describing solidification is carried out by the finite differences method. The cooling effect under the limits conditions transitory, produces a movement of the liquid–solid interface well determined. The temperatures' profiles obtained experimentally and numerically are identical, a light variation between the experimental and digital results in the liquid zone, following the fact of having neglected convection in liquid phase.

Key words: Solidification, heat transfer, phase change, finite difference, moving interface, cylindrical casting.

Introduction

The moulding of pieces is one of the methods promoters of production in the foundries. The design and efficient functioning of casting machines require a comprehensive analysis of the casting process in the moulds. The problems of phase change are different from the conventional problems of thermal transfer in the fact of the presence of free borders. The presence of the liquid-solid interface returns the equations model describing the process of solidification strongly nonlinear.

Several research projects have made signifying contributions on this subject. In the research work of the Meeting of Pune in India [1], the process for obtaining the pieces by moulding way is analyzed in depth manner; several issues are presented for