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Magnetohydrodynamic stability of oscillatory natural convection in a cylindrical enclosure filled with a liquid metal

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Abstract

We study the magnetohydrodynamics stability of oscillatory natural convection in a cylindrical enclosure filled with a liquid metal whose Prandtl number equal to 0.015, having an aspect ratio $A=H/r_c$ equal to 2, and subjected to an axial temperature gradient and a constant magnetic field. The finite volume method was used in order to solve the equations of continuity, momentum and energy. The flow stability is preserved for higher values of the Grashof number, *Gr*. The stability diagram was established according to the numerical results of this investigation. This diagram highlights the dependence of the critical Grashof, Gr_{Cr}, with the increase of the Hartmann number, *Ha*. This study confirms the possibility of stabilization of a liquid metal flow in natural convection by application of an axial magnetic field.

Key words: *Natural convection, Magnetic field, Oscillatory, Cylinder, Liquid metal*

1. Introduction

Liquid metal natural convection in enclosures to which a magnetic field is applied appears in the crystal growth processes. In general, the homogeneity and the quality of the crystals developed in the molten bath are of great interest for the manufacturers of the electronic components (Hurle, 1993). The temperature gradient within the melt (Fig.1), generates natural convective flow.

These motions are of great concern to the crystal grower, because they control the transport of dopant,

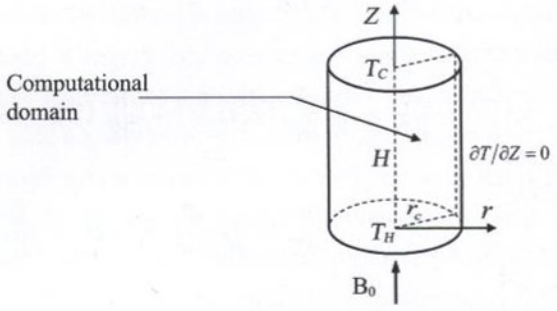

Fig. 1. The geometry of the problem.

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