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Mixed convection with entropy generation of nanofluid in a lid-driven cavity under the effects of a heat-conducting solid wall and vertical temperature gradient

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Abstract

Mixed convection combined with entropy generation of an alumina-water nanofluid in a lid-driven cavity with a bottom solid wall of finite thickness and conductivity has been examined numerically. Governing equations formulated in dimensionless stream function and vorticity variables on the basis of a single-phase nanofluid model under the effect of Brownian diffusion have been solved by finite difference method of the second-order accuracy. The effects of Richardson number (Ri = 0.01–10.0), thermal conductivity ratio ($1.0 \le K \le 20.0$), solid wall thickness ($0.1 \le \delta \le 0.3$) and nanoparticles volume fraction ($0 \le \phi \le 0.05$) on streamlines, isotherms and isentropic lines as well as average Nusselt number at solid-fluid interface and rate of fluid flow have been analyzed. It has been found that an increase in nanoparticles volume fraction leads to the heat transfer enhancement and reduction of the average Bejan number.

Keywords: mixed convection, lid-driven cavity, heat-conducting solid wall, nanofluid, isothermal horizontal walls, numerical results

1. Introduction

Lid-driven enclosures are famous problem in engineering due to different applications such as oil extraction, cooling of electronic equipments, design of heat exchangers, flow and heat transfer in solar ponds, crystal growth and float glass productions. It is also a good geometry to make a

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