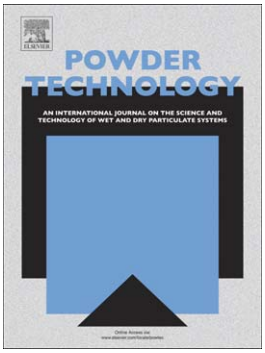

Increment of mixed convection heat transfer and decrement of drag coefficient in a lid-driven nanofluid-filled cavity with a conductive rotating circular cylinder at different horizontal locations: A sensitivity analysis

Soroush Mirzakhanlari, Kamel Milani Shirvan, Mojtaba Mamourian, Ali J. Chamkha

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Increment of Mixed Convection Heat Transfer and Decrement of Drag Coefficient in a Lid-Driven Nanofluid-Filled Cavity with a Conductive Rotating Circular Cylinder at Different Horizontal Locations: A Sensitivity Analysis

Soroush Mirzakhanlari[1], Kamel Milani Shirvan[2], Mojtaba Mamourian[2,*], Ali J. Chamkha[3, 4]

[1]Young Researchers and Elite Club, Qazvin Branch, Islamic Azad University, Qazvin, Iran
[2]Department of Mechanical Engineering, Ferdowsi University of Mashhad, Mashhad, Iran
[3]Mechanical Engineering Department, Prince Mohammad Bin Fahd University, Al-Khobar 31952, Saudi Arabia
[4]Prince Sultan Endowment for Energy and Environment, Prince Mohammad Bin Fahd University, Al-Khobar 31952, Saudi Arabia
*Corresponding author, E-mail: mamourian@um.ac.ir

Abstract

Since in most industrial rotating equipment, increasing thermal efficiency and reduction of drag has always been subject of interest, in this paper, a 2-D numerical investigation on mixed convection heat transfer and drag coefficient in a lid-driven square cavity filled with Al_2O_3 Nanofluid is done under the effect of an inner rotating cylinder. To analyze effective parameters on heat transfer and drag coefficient on movable wall, a sensitivity analysis is carried out utilizing the Response Surface Methodology. Simulations are performed for effective parameters of the Richardson number ($0.1 \leq Ri \leq 10$), dimensionless rotational speed ($0 \leq \Omega \leq 5$), a/b ratios ($0.5 \leq S \leq 1$), and the Nanoparticle volume fraction ($0.00 \leq \Phi \leq 0.03$) with a constant Grashof number of 10^4. It is found that the mean Nusselt number enhances with Ri number and Φ and decreases with increasing of Ω and S. Additionally, increasing the Ri number and Ω increases the drag coefficient but it reduces as Φ and S increase. The sensitivity analysis results showed that to maximize the mean Nu number and minimize the drag coefficient simultaneously, the effective parameters must be Ω=0, Ri = 0.13636, Φ=0.03 and S=0.5.

Keywords: Sensitivity Analysis; Lid-Driven Cavity; Heat transfer; Drag Coefficient; Nanofluid; Optimization.