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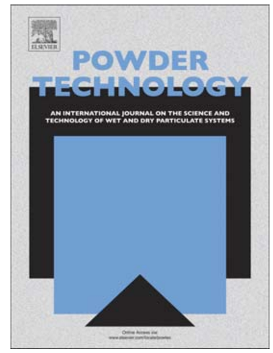

Transient natural convective heat transfer in a trapezoidal cavity filled with non-Newtonian nanofluid with sinusoidal boundary conditions on both sidewalls

A.I. Alsabery, A.J. Chamkha, H. Saleh, I. Hashim

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Transient natural convective heat transfer in a trapezoidal cavity filled with non-Newtonian nanofluid with sinusoidal boundary conditions on both sidewalls

A. I. Alsabery[a]*, A. J. Chamkha[b,c], H. Saleh[a] and I. Hashim[a,d]

[a]Center for Modelling & Data Analysis,
School of Mathematical Sciences,
Universiti Kebangsaan Malaysia,
43600 UKM Bangi, Selangor, Malaysia

[b]Department of Mechanical Engineering,
Prince Mohammad Bin Fahd University,
Al Khobar 31952, Saudi Arabia

[c]Prince Sultan Endowment for Energy and the Environment,
Prince Mohammad Bin Fahd University,
P.O. Box 1664, Al-Khobar 31952, Kingdom of Saudi Arabia

[d]Research Institute, Center for Modeling & Computer Simulation,
King Fahd University of Petroleum & Minerals,
Dhahran-31261, Saudi Arabia

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Abstract

Transient, laminar natural convection in a trapezoidal cavity filled with non-Newtonian nanofluid with sinusoidal boundary conditions on both sidewalls is studied numerically by using the finite element method. The sloping walls of the cavity are heated by sinusoidal temperature distributions, while the horizontal walls allow no heat transfer to the surrounding. Water-based nanofluids with Ag or Cu or Al_2O_3 or TiO_2 nanoparticles are chosen for investigation. The governing parameters of this study are the Rayleigh number ($10^4 \leq \mathrm{Ra} \leq 10^6$), phase deviation ($0 \leq \gamma \leq \pi$), amplitude ratio ($0 \leq \varepsilon \leq 1$), power-law index ($0.6 \leq n \leq 1.4$), sidewall inclination angle ($0^\circ \leq \varphi \leq 21.8^\circ$), nanoparticle volume fraction ($0 \leq \phi \leq 0.2$), and dimensionless time ($0 \leq \tau \leq 0.2$). The results show that the heat transfer rate increases significantly by the addition of phase deviation. Strong heat transfer enhancements are obtained by higher sidewall inclination angles. However, for a square cavity, the heat transfer approaches the steady-state condition with the increment of the dimensionless time.

Keywords: Transient Natural Convection; Trapezoidal Cavity; Finite Element Method; Non-Newtonian Nanofluid; Sinusoidal Boundary Conditions

*Corresponding author: ammar_e_2011@yahoo.com

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