Simulation of Magnetic Field Effect on Heat Transfer Enhancement of Swirling Nanofluid

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Abstract

In this paper, the swirling nanofluid flow which is driven by a rotating bottom disk of a cylindrical container under magnetic field effect and temperature gradient is considered. Effects of electrical conductivity of cylindrical walls on heat transfer enhancement are numerically analysed. The governing equations that describe the combined problem (MHD and mixed convection) under the adoptive assumptions are solved numerically by the finite volume technique. Calculations were made for fixed Reynolds number (Re=1000), Richardson number ($0 \leq Ri \leq 2$), aspect ratio ($H/R = 2$), Hartmann number ($0 \leq Ha \leq 60$), and solid nanoparticle (copper) with volume fraction ($\phi = 0.1$). A decrease in the mean Nusselt number was found with the increase of the Richardson number due to stratification layers. These latter limits the heat transfers between the hot and cold zones of the cylinder. The results indicate that the Nusselt number gets bigger within a certain range of Hartmann numbers, and especially when the rotating lid is electrically conducting. Indeed, average Nusselt number decreases while the Hartmann number increase after it exceeds a critical value. Finally, the electrical conductivity of the rotating lid plays an important role in heat transfer enhancement in nanofluid swirling flow.

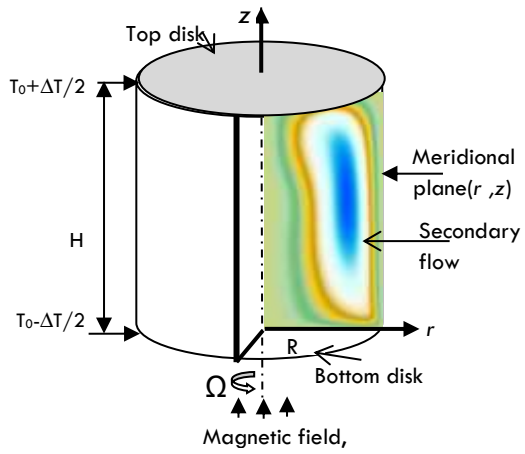


Fig. 1. Geometry under consideration.

Recent Publications

1. Sheikholeslami, M., Hatami, M., Ganji D.D., (2014) "Nanofluid flow and heat transfer in a rotating system in the presence of a magnetic field", J. Mol. Liq. (190), 112–120 https://doi.org/10.1016/j.molliq.2013.11.002
2. Sheikholeslami, M., (2017) "Influence of Lorentz forces on nanofluid flow in a porous cylinder considering Darcy model", *J. Mol. Liq*, (225),903–912. https://doi.org/10.1016/j.molliq.2016.11.022
3. Sheikholeslami, M., & Ganji, D. D. (2018)"Numerical investigation of nanofluid melting heat transfer between two pipes". *Alexandria Engineering Journal*, (57), 1261-1269, doi:10.1016/j.aej.2017.03.028
4. Mahfoud, B. and Bendjaghlouli, A. (2018) "Natural convection of a nanofluid in a conical container," Journal of Thermal Engineering (1), 1713–1723 DOI:10.18186/journal-of-thermal-engineering.367407
5. Mahfoud, B., (2021)" Effects of an Axial Magnetic Field on Vortex Breakdown and Fluid Layer" Journal of Applied Fluid Mechanics(14),1741–1753. https://doi.org/10.47176/jafm.14.06.32585



Biography

Brahim Mahfoud is presently a Professor in the Department of Mechanical Engineering, University of AMO-Bouira, Algeria. He received a Doctorate (PHD) degree in Mechanical Engineering, from Constantine University, Algeria in 2013. His research interests include heat transfer, Magnethohydrodynamic, Computational Fluid Dynamics, Nanofluid, Turbulence. He has published various articles in high-impact factor journals such as International journal of heat and mass transfer, Numerical Heat Transfer, Part A, Journal Thermophysics and Heat Transfer, European Journal of Mechanics-B/Fluids, etc.

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