

Examine the lattice Boltzmann method for the mixed convection simulation of water/ Al_2O_3 nanofluid in a 2D rectangular cavity under radiation with isothermal semicircular obstacles

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Abstract

The present study simulated the mixed convection (MCXN) of the water/ Al_2O_3 nanofluid (NFs) in a two-dimensional rectangular cavity in the presence of radiation. The top and bottom walls were assumed to be cold and hot, respectively, with the lateral walls being insulated. A magnetic field (MGF) with a Hartmann number (Ha) of 0–40 was applied to the NFs within the cavity. The simulations were carried out at a Richardson number (Ri) of 1 and a Rayleigh number (Ra) of 10^5 for cavity heights of 0.5–2.0 to evaluate heat transfer (HTF) on the walls and analyze fluid rotation within the cavity. The lattice Boltzmann method (LBM) was used to perform the simulations. It was found that the incorporation of radiation into the system reversed the flow rotation in the cavity and increased the Nu. A rise in the radiation parameter from 0 to 0.2 led to a 2.8-fold larger Nu on the cold wall. A rise in the cavity height decreased the Nu, and a further increase in the height increased the Nu on the wall. An increased Ha had an insignificant effect on the Nu at small cavity heights but decreased the Nu on the wall at large cavity heights.