عنوان مقاله:

Heat transfer and entropy generation of power-law fluids natural convection inside triangular cavity; The effect of angle and type of magnetic field applied

محل انتشار:

دو فصلنامه تجهیزات و سیستم های انرژی, دوره 10, شماره 4 (سال: 1401)

تعداد صفحات اصل مقاله: 27

نویسندگان:

Mohammad Nemati - *Department of Mechanical Engineering, Yazd University, Yazd, Iran*

Mohammad Sefid - *Department of Mechanical Engineering, Yazd University, Yazd, Iran*

Ali J. Chamkha - *Faculty of Engineering, Kuwait College of Science and Technology, Doha District, ۳۵۰۰۴ Kuwait*

خلاصه مقاله:

In the present work, heat transfer and entropy generation due to the natural convection of Newtonian and non-Newtonian fluids in two types of shear thinning and shear thickening inside a right-triangular cavity under the effect of uniform and non-uniform magnetic field by multiple relaxation time lattice Boltzmann methods have been investigated. The aspect ratio of the cavity is variable and the magnetic field is applied from left to right and perpendicular to the gravity of the cavity. The present work is validated with previous references and results presented in the form of tables, diagrams and streamlines, isothermal lines, and entropy lines. The simulation is done by writing the computer code in the Fortran language. The effect of Rayleigh number, aspect ratio, power-law index of fluid, Hartmann number and angle, and type of magnetic field applied on fluid flow and heat transfer characteristics has been evaluated. The results show that in all cases, increasing the Hartmann number and fluid power-law index leads to a decrease in the strength of flow, heat transfer rate, and entropy generated and the percentage of this effect varies depending on the number of other variables. By applying a magnetic field non-uniformly, the flow strength and heat transfer rate can be increased to about ۴۵% and ۲۰%, respectively. At higher Hartmann numbers, the effect of changing the type of magnetic field applied is more pronounced. The angle of the magnetic field applied is a determinant parameter on the amount of heat transfer so that the average Nusselt number in the horizontal mode is on average ۱۵% less than in the vertical mode. Increasing of power-law index dramatically reduces the magnetic field effect so that it is ineffective for the shear thickening fluid, the type of magnetic field applied. By increasing the Rayleigh number and the aspect ratio of the cavity, the flow strength and the rate of heat transfer increase and the effect of the magnetic field becomes more pronounced. This study can be useful in the optimal design of industrial and engineering equipment, including electronic coolers.

کلمات کلیدی:

Natural convection, Power-law Fluids, Non-uniform magnetic field, Entropy generation, Variable Aspect Ratio, Triangular Cavity, MRT-LBM