Heat Transfer Enhancement in a Lid-driven Enclosure Filled with Nanofluids

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ABSTRACT

Heat transfer fluids such as water, minerals oil and ethylene glycol play an important role in many industries including chemical production, power stations, transportation and microelectronics. The performance of these convectional heat transfer fluids is often limited by their low thermal conductivities. To overcome this drawback there is a strong motivation to develop advanced heat transfer fluids with substantially higher conductivities to enhance thermal characteristics. Therefore fluids with suspended metallic nanoparticles are expected to have better heat transfer properties compared to the convectional heat transfer fluids [1,2].

Mixed convection in a lid-driven square enclosure utilizing nanofluids is numerically investigated for various pertinent parameters. The governing equations are solved numerically with finite volume method using SIMPLE algorithm. Comparisons with previously published work on the basis of special cases are performed and found to be in excellent agreement. The top moving wall and the left vertical wall are maintained at different constant temperatures while the right vertical and bottom walls are thermally insulated. Two cases were considered depending on the direction of the moving wall. Numerical solutions are obtained for a wide range of parameters. Copper water nanofluid is used with Pr=6.2 and solid volume fraction χ is varied as 0% to 20%. It is found that decreasing value of Richardson number and increasing value of volume fraction of nanofluids causes an increase in the average heat transfer coefficient. The nanoparticles are capable of changing the flow pattern for particular case. The streamline and isotherm plots and the variation of the average Nusselt numbers at the hot wall are presented and discussed. The chief objective of the present numerical investigation is to examine the characteristics of a lid-driven two-dimensional square cavity filled with nanofluid. The present study is focused on the analysis of several pertinent parameters on the heat transfer characteristics of nanofluids within the enclosure. This problem may be encountered in a number of electronic cooling and MEMS applications.

REFERENCES

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