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Evaluation of Heat Transfer and Entropy Generation by Al2O3-Water Nanofluid

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Abstract : In this numerical work, natural convection and entropy generation of Al₂O₃–water nanofluid in square cavity have been studied. A two-dimensional steady laminar natural convection in a differentially heated square cavity of length L, filled with a nanofluid is investigated numerically. The horizontal walls are considered adiabatic. Vertical walls corresponding to x=0 and x=L are respectively maintained at hot temperature, T_hand cold temperature, T_c. The resolution is performed by the CFD code "FLUENT" in combination with GAMBIT as mesh generator. These simulations are performed by maintaining the Rayleigh numbers varied as 10³ ≤ Ra ≤ 10⁶, while the solid volume fraction varied from 1% to 5%, the particle size is fixed at dp=33 nm and a range of the temperature from 20 to 70 °C. We used models of thermophysical nanofluids properties based on experimental measurements for studying the effect of adding solid particle into water in natural convection heat transfer and entropy generation of nanofluid. Such as models of thermal conductivity and dynamic viscosity which are dependent on solid volume fraction, particle size and temperature. The average Nusselt number is calculated at the hot wall of the cavity in a different solid volume fraction. The most important results is that at low temperatures (less than 40 °C), the addition of nanosolids Al₂O₃ into water leads to a decrease in heat transfer and entropy generation instead of the expected increase, whereas at high temperature, heat transfer and entropy generation increase with the addition of nanosolids. This behavior is due to the contradictory effects of viscosity and thermal conductivity of the nanofluid. These effects are discussed in this work.

Keywords : entropy generation, heat transfer, nanofluid, natural convection
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