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Mixed convection of Al2O3-water nanofluid in a double lid-driven square cavity with a solid inner insert using Buongiorno's two-phase model
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Abstract
The present paper investigates steady conjugate mixed convection in a double lid-driven square cavity including a solid inner body. The annulus is filled with water-Al2O3 nanofluid based on Buongiorno's two-phase model. The top horizontal wall is maintained at a constant low temperature and moves to the right while the bottom horizontal wall is maintained at a constant high temperature and moves to the left. The governing equations are solved numerically using the finite element method. The governing parameters are the inner solid location (case 1-case 4), the nanoparticles volume fraction ($0 \leqslant \phi \leqslant 0.04$), Reynolds number ($1 \leqslant Re \leqslant 500$), Richardson number ($0.01 \leqslant Ri \leqslant 100$), the size of the inner solid ($0.1 \leqslant D \leqslant 0.7$) and thermal conductivity of the inner solid (kw=0.01, 0.045, 0.1, 0.76 and 1.95 W/m °C). The other parameters; Prandtl number, Lewis number, Schmidt number, ratio of Brownian to thermophoretic diffusivity and the normalized temperature parameter are fixed at Pr=4.623,Le=3.5×105,Sc=3.55×104,NBT=1.1 and δ=155, respectively. The results show that the nanofluid strategy in such a cavity has a noticeable augmentation of heat transfer. However, at low Reynolds number, the addition of nanoparticles has an adverse effect on the Nusselt number when the Richardson number is very high. It is also found that a big size solid body can augment heat transfer in the case of high values of both the Reynolds and the Richardson numbers. © 2017 Elsevier Ltd

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