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The comparison of double-diffusive mixed convection in square driven cavities with one and two moving lids

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Abstract

In this study, the unsteady double-diffusive mixed convection in the one and two-sided lid-driven cavities are studied and compared together using numerical SIMPLE algorithm. Uniform but different temperatures and mass concentrations are assumed at horizontal walls. The used fluid (pure air) was assumed incompressible and Newtonian. The used numerical method is firstly validated against previously published numerical results. Then, the numerical simulations were carried out for almost a wide range of Richardson number, whereby the study of various convection regimes would be possible. Results show that the convection heat and mass transfer are reduced with increasing Richardson number. The conductive mode of heat transfer is enhanced by increasing Ri value, so cavities are quasi-conductive domains when fluid flow was dominated by free convection. It was also observed that the heat and mass are better transferred in two-sided lid-driven cavities with respect to the other ones which was due to the extra mechanical forces imposed by the two-sided lids movement. The velocity profile variations demonstrate that the flow is decelerated with increasing Richardson number especially near the bottom horizontal wall. It has also been found that both of entropy generation and total kinetic energy reduce as either Richardson number enhances or two-sided lids movement reduces to one-sided lid movement.

Keywords: double-diffusive convection, diffusion, conduction, heat and mass transfer, entropy

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