THE EFFECT OF VARIABLE LEWIS NUMBER ON THE TEMPERATURE AND CONCENTRATION PATTERNS IN A SQUARE CAVITY

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INTRODUCTION. As seen, Alcoke [1] expressed that in a binary gas mixture, the mass diffusivity variations depend on $T^{3/2}$ and the viscosity, and the thermal conductivity change with $T^{1/2}$. Also, Bird et al. [2] showed that the mass diffusivity changes with $T^{2.34}$ for H_2O and a nonpolar gas. Therefore, we consider a simple assumption; in which, the temperature dependence of the mass diffusivity is dominant in a binary gas mixture and other properties are constant. In this paper, a square cavity filled with double diffusion convection coupled to participation gray radiation which was studied by Mezrhab et al. [3] is considered. However, in this work, the effect of variable mass diffusivity (316 K< T <634 K) is investigated on the temperature and concentration distributions in the cavity.

1. METHODOLOGY

The dimensionless equations of a considered medium are as below:

$\partial U_i/\partial X_i = 0$: Continuity $\quad U_j \partial U_i/\partial X_j = -\partial P/\partial X_i + pr\left(\partial/\partial X_j(\partial U_i/\partial X_j)\right) + e_2 Ra\, pr(\theta + \eta N_{CT} C)$: Momentum Eqs. (1)

$U_j \partial C/\partial X_j = \partial/\partial X_j\left(Le^{-1}(T,P)\partial C/\partial X_j\right)$: Concentration $\quad U_j \partial\theta/\partial X_j = \partial/\partial X_j\left(\partial\theta/\partial X_j\right) - \theta_0/Pl(\partial Q_{rj}/\partial X_j)$: Energy Eqs. (2)

2. RESULTS AND DISCUSSION

As Fig. 1b for variable Le number shown, the low concentration (C< 0) dominates in the cavity; also, as seen by ref [3], the optical thickness is related to the concentration as $\tau=\tau_0(C+0.5)$; thus, the low concentration causes the decrease of optical thickness, and the increase of radiation heat transfer in the case. So, the total heat fluxes are increased (Fig. 1c). Also, Fig. 1a shows isothermal lines which are nearer to the cold wall for the variable Le number in comparison to the constant Le number case.

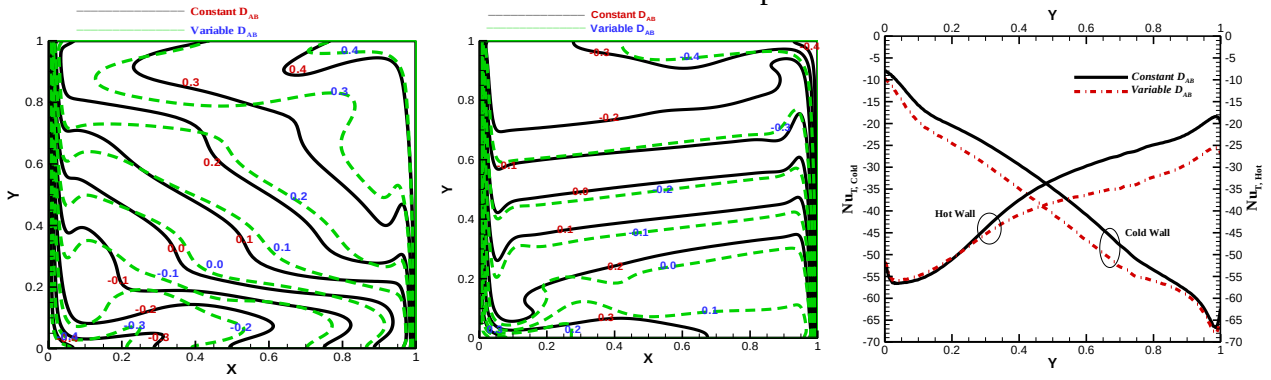

Figure1. Effect of variable Le a) temperature contours, b) concentration contours, c) Nu_{Total} for $\eta = -1, N_{CT} > 0$, τ_0=5

3. CONCLUSION

The results showed that due to the dependence of the Le number on the temperature, we could control the optical thickness in the cavity for high τ_0 and increased total heat flux in a cooperating flow.

REFERENCES

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