ABSTRACT

The present study is a numerical study of double-diffusive mixed convective flow in ventilated rectangular cavity in the presence of heat and mass generating square solid body placed at the center of the bottom wall. The bottom and top walls of the cavity are insulated and impermeable. An external Newtonian fluid flow enters the cavity through an opening at the top of the left vertical wall and exits from another opening at the bottom of the right vertical wall, hence forced convection flow conditions are created. This study is only confined to laminar flow regimes under steady state conditions. The governing equations including continuity, momentum, energy and species transfer are transformed into non-dimensional form and the resulting partial differential equations are solved by a finite volume discretization.

A parametric study presenting the influence of Reynolds number (Re), Richardson number (Ri), heat generation and absorption coefficients (ϕ) and fluid inlet angle (γ) effect on the fluid velocity, temperature distribution and species concentrations, as well as average Nusselt number and is done. This numerical study is carried out using the flowing assumptions; constant Prandtl number, Pr = 0.7; aspect ratio, A = 2, Lewis number, Le = 2 and Buoyancy ratio, N = 0.5. Computations are carried out for Reynolds numbers ranging from 100 to 1000, Richardson number ranging from 0.1 to10, fluid inlet angle range of $0° \leq \gamma \leq 30°$, dimensionless heat generation range of $0.5 \leq \phi \leq 2.5$.

The concluding chapter illustrates that effect of Richardson number on the heat and mass transfer in the ventilated cavity including a heat and mass source. It was found that the Richardson number has the major influence on the flow distribution inside the cavity. Also, the heat transfer rate decreases with the increase of the Richardson number when the forced convection regime is dominating or it can be said at very low values of Richardson number. On the opposite, at high values of Richardson number at which the natural convection has the main effect on the fluid flow, the increase of the Richardson number increases the average Nusselt number as a result of the higher heat transfer rate but this rise does not reach the heat transfer rate when the forced convection is dominated. Moreover, the fluid inlet angle affects the average Nusselt number which has a maximum value at $\gamma = 20°$. On the other

hand, it does not have a significant effect on the flow distribution in the enclosure but it has a clear effect on the isotherms and the isoconcentrations. Finally, the heat generation has no effect on the streamline, isotherm and isoconcentration contours but its influence appears on the average Nusselt number which increases with the increase of the heat generation coefficient.