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Thermo-solutal buoyancy-opposed free convection of a binary Ostwald-De Waele fluid inside a cavity having partially-active vertical walls
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Abstract
The present study investigates double-diffusive free convection of a non-Newtonian fluid inside a cavity having discretely active walls of source and sink for heat and solute mass. The Ostwald-De Waele model has been adopted for non-Newtonian fluid behavior. Five discrete heating and salting arrangements in the vertical walls are considered in the present analysis. A numerical solution is obtained using the control volume-based integration technique. The Modified Marker and Cell (MMAC) method is used for obtaining the numerical solution of the governing equations. A gradient-dependent consistent hybrid upwind scheme of second order (GDCHUSSO) is used for the discretization of the convective terms. The effect of the power-law index and the buoyancy ratio for different heating and salting arrangements has been analyzed to determine the heat and mass transfer characteristics. Interesting results of stability at a critical buoyancy ratio is noticed for dilatant fluids. The isotherm, isoconcentration and flow line contour maps are provided to bring the clarity in the understanding of flow, temperature and mass distributions for different arrangements. Graphical and tabular records of heat and mass transfer characteristics are provided for understanding the various effects of the pertinent parameters. © 2015 Taiwan Institute of Chemical Engineers.

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