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Numerical investigation of double-diffusive convection in an open cavity with partially heated wall via heatline approach
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Abstract
Double-diffusive natural convection in an open top square cavity, partially heated and salted from the side, is studied numerically via the heatline approach. Constant temperatures and concentrations are imposed along the right and left walls, while the heat balance at the surface is assumed to obey Newton's law of cooling. The finite difference method is used to solve the dimensionless governing equations. The governing parameters involved in this investigation are the thermal Marangoni number (0 ≤ MaT ≤ 1000), the solutal Marangoni number (0 ≤ Mac ≤ 1000), the Lewis number (10 ≤ Le ≤ 100), the heater size, (0.2 ≤ s ≤ 0.8), Grashof number, Gr = 104, Prandtl number, Pr = 10, Biot number, Bi = 0.1 and aspect ratio 1. The numerical results are reported for the effect of the Marangoni number, Lewis number and heater size on the contours of streamlines, isotherms, isoconcentrations, masslines and heatlines. The predicted results for the average Nusselt number and Sherwood number are presented for various parametric conditions. It is shown that the heat and mass transfer mechanisms are affected by the heater segment length. A direct relation between both opposing (N = -2) and aiding flow (N = 2), and heat and mass transfer process is found for various values of the Marangoni and Lewis numbers. © 2015 Elsevier Masson SAS.

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