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Numerical model to study natural convection in a rectangular enclosure filled with two immiscible fluids ☆

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Abstract

A finite-difference approximation of the Navier–Stokes equations under the Boussinesq-fluid assumption is used to simulate the flow and heat transfer in a two-layer system of an immiscible incompressible fluid. The numerical model is validated with a benchmark solution which is buoyancy-driven flow in a square cavity with differently heated vertical sides. The results of the two-dimensional numerical simulation are compared with the experimental data of the hydrodynamics and heat exchange within a horizontal two-layer medium consisting of two immiscible liquids of different densities and viscosities. Comparisons are made for the profiles of the temperature and for the profiles of the horizontal and vertical components of the velocity vector as well. Qualitative agreement between numerical and experimental results is observed.

Keywords: Natural convection; Two-layer; Two-dimensional numerical simulation