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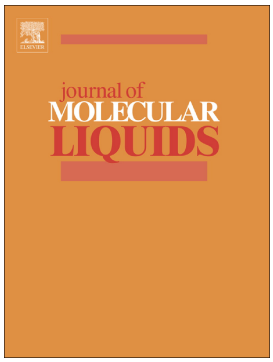

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Heat flow visualization of a chemical compound isobutane (C_4H_{10}) past a vertical cylinder in the subcritical, near-critical and supercritical regions

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Abstract

Supercritical fluids (SCF) found to have large number of application in science and engineering field particularly in separation, green technologies etc. The present research paper investigates the heatline visualization of unsteady free convection supercritical fluid flow over a vertical cylinder using Bejan's heat function concept and utilizing isobutane as a model compound. A new model has been obtained to calculate the volumetric thermal expansion coefficient (β) based on the Redlich-Kwong equation of state (RK-EOS), in order to calculate the free convection properties of isobutane in SCF region. In this model the thermal expansion coefficient is characterized as a function of compressibility factor, temperature and pressure. Crank-Nicolson type of implicit finite difference method is utilized to obtain the results in terms of the streamlines (ψ), isotherms (θ) and healines (Π) for the different values of reduced temperature and reduced pressure in the SCF region. The numerically calculated thermal expansion coefficient values are validated with existing experimental results. Numerical simulations are performed for isobutane in three regions namely, subcritical, near critical and supercritical regions. The unsteady boundary layer flow analysis shows that the streamlines are beginning from the leading edge to the far downstream, whereas the heatlines ends at a finite distance from

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