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A study of pressure-driven displacement flow of two immiscible liquids using a multiphase lattice Boltzmann approach[1] PRASANNA REDAPANGU, Department of Chemical Engineering, Indian Institute of Technology Hyderabad, Yeddumailaram 502 205, Andhra Pradesh, India, PRATAP VANKA, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, USA, KIRTI SAHU, Department of Chemical Engineering, Indian Institute of Technology Hyderabad, Yeddumailaram 502 205, Andhra Pradesh, India — The pressure-driven displacement of two immiscible fluids in an inclined channel in the presence of viscosity and density gradients is investigated using a multiphase lattice Boltzmann approach. The effects of viscosity ratio, Atwood number, Froude number, capillary number and channel inclination are investigated through flow structures, front velocities and fluid displacement rates. Our results indicate that increasing viscosity ratio between the fluids decreases the displacement rate. We observe that increasing the viscosity ratio has a non-monotonic effect on the velocity of the leading front; however, the velocity of the trailing edge decreases with increasing the viscosity ratio. The displacement rate of the thin-layers formed at the later times of the displacement process increases with increasing the angle of inclination because of the increase in the intensity of the interfacial instabilities. Our results also predict the front velocity of the lock-exchange flow of two immiscible fluids in the exchange flow dominated regime.

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