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Rayleigh–Taylor problem for a liquid-liquid phase interface XUEMEI CHEN, ELIOT FRIED, Washington University in St Louis — A linear stability analysis of the two-dimensional Rayleigh—Taylor problem for an incompressible fluid undergoing a liquid-liquid phase transformation is presented. Both inviscid and viscous fluids are considered and interfacial tension is taken into account. Instability is possible only when the phase with the higher density is above that with the lower density. Study of the inviscid case shows that the exchange of mass between the phases decreases significantly both the range of unstable wave numbers and the maximum growth rate for unstable perturbations as compared to those arising classically. For a linearly viscous fluid, the shear and dilational viscosities of the interface are taken into account as are the migrational viscosities associated with the motion of the interface relative to the underlying fluid. When no mass exchange occurs between the phases in the base state and the interfacial viscosities are neglected, the growth rates exceed by at least an order of magnitude those for the classical Rayleigh—Taylor problem. The various interfacial viscosities slow the growth rates of disturbances but do not influence the range of unstable wave numbers. For both the inviscid and viscous cases, interfacial tension plays the same stabilizing role. We extend the result to three-dimensional disturbance and find that any instability that may be present for a three-dimensional disturbance is also present for a two-dimensional disturbance involving a smaller wave length.

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