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Unifying binary fluid diffuse-interface models in the sharp-interface limit DAVID SIBLEY, ANDREAS NOLD, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London, UK — Flows involving free boundaries occur widely in both nature and technological applications, existing at liquid-gas interfaces (e.g. between liquid water and water vapour) or between different immiscible fluids (e.g. oil and water, and termed a binary fluid). To understand the asymptotic behaviour near a contact line, a liquid-gas diffuse-interface model has been investigated recently [1]. In contrast, here we investigate the behaviour between two ostensibly immiscible fluids, a binary fluid, using related models where the interface has a thin but finite thickness. Quantities such as the mass fraction of the two fluid components are modelled as varying smoothly but rapidly in the interfacial region. There has been a wide variety of models used for this situation, based on Cahn–Hilliard or Allen–Cahn theories coupled to hydrodynamic equations, and we consider the effect of these differences using matched asymptotic methods in the important sharp-interface limit, where the interface thickness goes to zero. Our aim is to understand which models represent better the classical hydrodynamic model and associated free-surface boundary conditions.

[1] Sibley, Nold, Savva, Kalliadasis. Eur. Phys. J. E 36, 26 (2013)

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