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Stability of a density-change flow in the solidification of a ternary alloy PETER GUBA, Comenius University, DANIEL ANDERSON, George Mason University — We consider phase-change driven flow and solidification of a ternary (three-component) alloy. The ternary system is characterized by the formation of two distinct mushy layers (primary and secondary), distinguished by the number of components present in their solid phases. A primary layer has the solid phase composed of a single component and, beneath the primary layer, a secondary layer has the solid phase composed of two components. Generally, the densities of the liquid, primary solid and secondary solid phases during solidification are different, and these differences give rise to a flow of the interstitial liquid. We identify four different flow regimes dependent upon whether the two solid phases shrink or expand upon solidification. The stability of this density-change flow in the absence of buoyancy is studied numerically applying a spectral method. A simple power law is employed to describe the permeability of the ternary mushy layers, with a sensitivity of permeability to changes in porosity used as the control parameter. An instability is found to occur not only in the case of expansion but also contraction, an option that is apparently unavailable for the binary case. A reduced model is derived which contains the bare essentials required to capture this instability.

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