BUBBLES IN FLUIDISED BEDS

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The connection between the instability of one-dimensional waves to transverse disturbances and the formation of bubbles in fluidised beds is still unclear. Moreover, recent theoretical and experimental studies have observed the formation of bubbles in gas-fluidised beds, but not in liquid-fluidised beds and, despite a detailed characterisation of the structures is already available, the physical mechanism leading to this differentiation is still unknown. In this work, we focus on the study of the instability of the one-dimensional concentration waves to transverse disturbances, leading to gravitational overturning. We propose an extension of models available in the literature to describe the gravitational instability of unbounded stratified flows to account for the slip velocity between the particles and the fluid, and also to include the inertia of the particles. The rheology of the particulate phase is simplified to retain only the relevant mechanisms in the model. A linear stability analysis is performed in order to determine the dispersion relation of the transverse modes. In addition, a numerical simulation of the full governing equations is carried out and is checked against the theoretical results of the linear stability. The influence of the physical parameters and constitutive relations of the particulate phase rheology in the stability of the waves is evaluated. It is found that fluidised beds are gravitationally unstable to long wavelength transversal modes. However, the results obtained here indicate that the enhanced drag of the fluidising flow on heavy concentrated regions tends to lift them, reducing the growth rates of long waves and even stabilising short waves.

In this work, we focus on the study of the instability of the one-dimensional concentration waves in fluidised beds to transverse disturbances, leading to gravitational overturning. The rheology of the particulate phase is simplified and a linear stability analysis, as well as a numerical simulation of the full governing equations, are performed. It is found that fluidised beds are gravitationally unstable to long wavelength transversal modes, and results indicate that the enhanced drag of the fluidising flow on heavy concentrated regions tends to lift them, reducing the growth rates of long waves and even stabilising short waves.