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Segregation in binary mixtures

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To investigate the vertical structure of free-surface liquid-granular flows, it is of particular interest to be able to materialise steady flow conditions. In the recent past, a thorough activity has been devoted to the rheology of flowing mixtures of well-sorted granular particles and water (Armanini et al., 2005). In this contribution, we present a preliminary analysis of the evolution, in time and space, of bimodal mixtures in quasi-uniform condition. In accordance with experimental evidence given by Savage & Lun (1988), Gray & Hutter (1997) and Gray (2001), segregation phenomena of particles of different sizes have been observed, with the formation of layers with the largest particles on top and the smaller at the bottom. This phenomenon has been investigated with the support of a newly developed imaging technique, based on the development of findings by Spinewine et al. (2003), able to tackle non-uniformly sized granular materials (within IMPACT European Project, 2001-2004). Moreover, special devices were built to allow width-average and local measurements of the distribution of the relative, and absolute, solid-concentration of the two size fractions. Furthermore, data from sidewall image and local measurements allow also to infer some information about three dimensional effects. The larger sediments employed are PVC particles with an equivalent-spherical diameter equal to 3.7 mm, also utilized for the experiments with a single size-fraction, while the smaller are quite uniform plastic spheres having a mean diameter of 0.9 mm. Both materials have a density of about 1570 kg/m3. In the experiments, a mixture of water and sediments was introduced steadily in the upstream part of the flume in well-mixed conditions, with a quite uniform distribution of both granulometric classes throughout the flow depth. Setup, initial and boundary conditions have been designed to have flows running over the rigid rough pavement of the flume, with no deposition phenomena. A progressive particle segregation was observed in downstream direction, with the larger particles migrating upwards and the smaller ones downwards. The distance measured experimentally at which segregation is almost complete was compared with the values predicted by the theory of Vallance

& Savage (2000). Theoretical results can be considered results in good accordance with experimental evidence.

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