



Laboratory experiment on boundaries of upper stage plane bed regime

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Results are discussed of laboratory experiments on criteria determining the transition between the regime of dunes and the upper stage plane bed (UPB) regime and the transition between the UPB regime and the regime of wavy flow. The experiments were carried for 3 fractions of plastic material and two fractions of glass beads in a broad range of flow conditions (different discharges of water and solids and longitudinal bed slopes) in a tilting flume.

The experiments reveal that, contrary to expectations, a constant value of the Shields parameter is not an appropriate criterion for the transition between the dune regime and the UPB regime. Furthermore, the transition appears to be insensitive to the total discharge of solids and water. Instead, the criterion seems to be well represented by a constant value of the average transport concentration of sediment (the ratio of volumetric discharge of solids and volumetric discharge of mixture). The experimental results exhibit a very tight correlation between the transport concentration and the longitudinal bed slope. Hence, a constant value of the bed slope can be considered an appropriate criterion for the transition.

The transition between the UPB regime and the wavy regime (significant waves develop but they are not always standing waves) is found at a constant value of Froude number, which is in agreement with literature, although it is found at a higher value than the literature usually suggests ($Fr = 1.2$ instead of 1.0). Hence, the transition occurs in the super-critical flow but it is not necessarily associated with the critical flow.