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Experimental study of the solid-liquid interface in a yield-stress fluid flow upstream of a step LI-HUA LUU, PHILIPPE PIERRE, CHAMBON GUILLAUME, IRSTEA — We present an experimental study where a yield-stress fluid is implemented to carefully examine the interface between a liquid-like unyielded region and a solid-like yielded region. The studied hydrodynamics consists of a rectangular pipe-flow disturbed by the presence of a step. Upstream of the step, a solid-liquid interface between a dead zone and a flow zone appears. This configuration can both model geophysical erosion phenomenon in debris flows or find applications for industrial extrusion processes. We aim to investigate the dominant physical mechanism underlying the formation of the static domain, by combining the rheological characterization of the yield-stress fluid with local measurements of the related hydrodynamic parameters. In this work, we use a model fluid, namely polymer micro-gel Carbopol, that exhibits a Hershel-Bulkley viscoplastic rheology. Exploiting the fluid transparency, the flow is monitored by Particle Image Velocimetry thanks to internal visualization technique. In particular, we demonstrate that the flow above the dead zone roughly behaves as a plug flow whose velocity profile can successfully be described by a Poiseuille equation including a Hershel-Bulkley rheology (PHB theory), with exception of a thin zone at the close vicinity of the static domain. The border inside the flow zone above which the so-called PHB flow starts, is found to be the same regardless of the flow rate and to move with a constant velocity that increases with the flow rate. We interpret this feature as a slip frontier.

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