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Gas-Liquid Flow Regimes in Vertical Venturi Downstream of Horizontal Blind-Tee

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Abstract : A venturi device is commonly used as an integral part of a multiphase flowmeter (MPFM) in real-time oil-gas production monitoring. For an accurate determination of individual phase fraction and flowrate, a gas-liquid flow ideally needs to be well mixed in the venturi measurement section. Partial flow mixing is achieved by installing a venturi vertically downstream of the blind-tee pipework that 'homogenizes' the incoming horizontal gas-liquid flow. In order to study in-depth the flow-mixing effect of the blind-tee, gas-liquid flows are captured at blind-tee and venturi sections by using a high-speed video camera and a purpose-built transparent test rig, over a wide range of superficial liquid velocities (0.3 to 2.4m/s) and gas volume fractions (10 to 95%). Electrical capacitance sensors are built to measure the instantaneous holdup (of oil-gas flows) at the venturi inlet and throat. Flow regimes and flow (a)symmetry are investigated based on analyzing the statistical features of capacitance sensors' holdup time-series data and of the high-speed video time-stacked images. The perceived homogenization effect of the blind-tee on the incoming intermittent horizontal flow regimes is found to be relatively small across the tested flow conditions. A horizontal (blind-tee) to vertical (venturi) flow-pattern transition map is proposed based on gas and liquid mass fluxes (weighted by the Baker parameters).

Keywords : blind-tee, flow visualization, gas-liquid two-phase flow, MPFM
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