EFFECT OF GEOMETRICAL RESTRICTION IN GAS-LIQUID FLOW

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The flow of a mixture of two fluids in pipes can be frequently encountered in nuclear, chemical or mechanical engineering, where gas-liquid reactors, boilers, condensers, evaporators and combustion systems can be used. The presence of geometrical singularity in pipes may affect significantly the behaviour of two-phase flow and subsequently the resulting pressure drop. Therefore, it is an important subject of investigation in particular when the application concerns industrial safety valves.

In this project, two-phase (gas-liquid) flow phenomena are investigated. The main objective is to determine the pressure drop in presence of a geometrical restriction and to analyze its effect on the flow pattern. The project is split in the following steps. At first, experiments are carried out in the already existing U-loop LUCY I where different types of restrictions are tested for single and two-phase flow. The facility is then modified to have a test section constituted of a new gas injector, a long horizontal pipe and a central flow obstruction (LUCY II). A new campaign of pressure drop measurements is conducted.

Flow visualization shows that several flow patterns can be formed in the facilities. Although bubbly flow remains the dominant flow regime, some others as slug and annular flow are also observed so that a flow regime map may be established (figure 1). The single and two-phase pressure drop data are compared to published correlations. The two-phase flow results show that the Lockhart-Martinelli parameter increases with the volumetric quality, but experiences smaller values in presence of pipe restriction compared to free pipe flow data (figure 2). It is concluded that geometrical accident has a dominant effect on two-phase flow pressure drop.

As future work, same experiments will be repeated on the facility of the French company CETIM, which mimics LUCY II features at scale 2. It is expected that the results of this test campaign will lead to put in evidence the effect of the scaling factor on the pressure drop in pressure drop correlation.

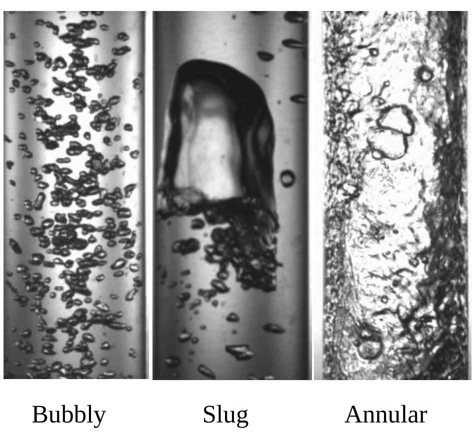

Figure 1: Two-phase flow regimes

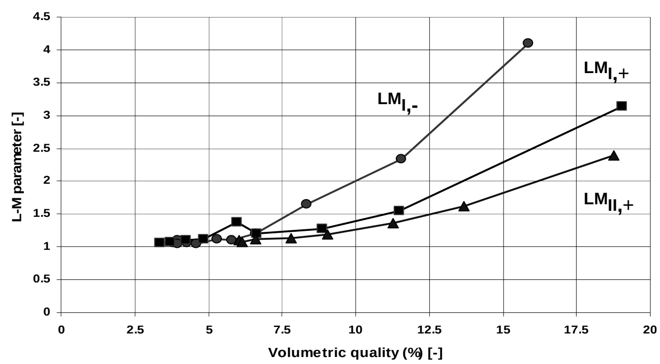

Figure 2: Two-phase flow correlation