VOID FRACTION IN HIGHLY TURBULENT AND LARGE DIAMETER HORIZONTAL PIPE FLOW

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ABSTRACT

This study presents an experimental correlation of void fraction distribution in large diameter horizontal pipe flow. A turbulent air-water mixture flows through a series of 8-in. diameter pipes, with a Reynolds number of 2.10^6 on a liquid basis and a 30% maximum flow volumetric quality under normal operating conditions. A double conical hot film probe has been designed to measure simultaneously the void fraction and the bubble velocity. The hot film probe has been calibrated in a 2-in. diameter pipe with bubble flow. Measured local void fractions have been corrected by the quick closing valves global method through an improved calibration procedure. Tests have been carried out along the pipe axis and in both cross-sectional planes. Fully-developed flow is identified at a distance more than 100 times pipe diameter from the mixer. Non-uniformity of the profiles is reviewed only in the transversal/transversal plane. Void measurements in the large-diameter horizontal pipe are found to be qualitatively comparable with numerical results in a 1.0-in. diameter horizontal pipe (Brown and Kranich [9, 43]). Two new sets of correlations are proposed here. The first predicts the longitudinal distribution of void fraction, where correlations are expressed in terms of axial location and flow volumetric quality. In the second, distribution of the void fraction in the transversal plane may be predicted either by a linear or an exponential model. Void fraction profiles are found to be almost flat in the radial/horizontal plane for which the power law may be assumed.