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Perspective

Techniques for Reducing Turbulence in Piv-Ps-Plif

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Description

The main elements influencing the gas-liquid two-phase flow and turbulent features in the 180-degree elbow are the curvature effect and bubbles. Little is known about the two-phase flow evolution and turbulent modulation in 180-degree elbow due to the complexity of experimental measurement and numerical analysis. The two-phase properties of a 180-degree elbow were investigated using a gas-liquid two-phase measurement technology called simultaneous Particle Image Velocimetry and Pulsed Shadowgraphy (PIV-PS), which was developed by fusing two cameras with a spectroscope and optical filters. Additionally, a bubble area detection and residual particle estimation-based picture post-processing technique was put out. Experimental research on the properties of the 180-degree elbow's velocity and turbulent fields has been done under a variety of circumstances, and a thorough examination of the elbow's flow field's evolution has also been done. The findings demonstrate that the horizontal velocity along the elbow's centerline rises linearly as the liquid flow rates. However, the linear feature is gone once bubbles are present. The turbulent fields demonstrate that, in bubble accumulation locations, the presence of bubbles reduces turbulence under low void fraction conditions and increases it under high void fraction conditions.

The curvature and bubble motions both have an impact on the two-phase flow behavior in a 180-degree elbow. It is challenging to investigate the specific properties of the flow and turbulent events because of the intricacy of the nonlinear interactions of bubbles, curved walls, and turbulence in the continuous phase. At order to overcome the challenges brought on by gas-liquid interfaces; optical phase discrimination is a crucial component of the measurement technique development for two-phase flow in 180-degree elbow. The PIV-PLIF (Planar Laser-Induced Fluorescence) approach, which was recently utilized to quantify the turbulent flow of gas and liquid, the digital masking technique, and the Pulsed Shadowgraphy (PS) technique are three commonly used methods for optical phase discrimination. Due to its potent capacity to capture the gas-liquid interfaces, the PS method is a common but effective phase separation technique. This is crucial for the ensuing image processing procedure. Have created a way for employing the PS approach to simultaneously assess the size and speed of particles in scattered two-phase flows. In a horizontal pipe, simultaneously measured the PIV and PS at high speeds, and the velocity and turbulence fields in various two-phase flow patterns were obtained. A simultaneous PIV-PLIF and PS approach was recently employed to examine the air core in a swirling separator.

It is challenging to conduct PIV-PS measurement for the middle elbow of the serpentine tube due to limitations imposed by the design of the experiment loop. Additionally, according to the high-speed experimental results of the test elbow is a suitable test section to conduct PIV-PS measurement experiments to look into the two-phase flow and turbulent characteristics of 180-degree elbows due to its uniform gas volume fraction distribution and visualize results at its inlet. Additionally, the test section's bubble size distribution and other inflow conditions can be found in our earlier study additionally, a viewing box that fills with water is placed outside

the 180-degree elbow to lessen the effect of the refractive index. The Reynolds numbers in the current work vary from 40,000 to 60,000 (depending on the liquid-phase information, i.e., the liquid bulk velocity and kinematic viscosity). If the flow pattern switches from bubbly flow to slug flow, the fall in the interfacial area concentration will also result in a decline in the efficiency of mass transfer. As a result, it's important to make sure the experimental circumstances are in the region of bubbly flow. The experimental parameters that were chosen are based on the results of the bubble-slug flow transition boundary in the serpentine tube. It should be noted that the void percent is constrained by the experimental apparatus and cannot surpass 1.8%.