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Fluid Dynamics and Transport Phenomena

Investigating the flow characteristics of air-lift pumps operating in gas-liquid two-phase flow☆

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Abstract: Experiments were conducted to investigate the flow characteristics in the riser pipe and the suction pipe of airlift pump at a series of air flow rates and submergence ratios by using a high speed camcorder and a Laser Doppler Velocimetry system (LDV). A modified model was developed to predict the performance of airlift pump operating in gas-liquid two-phase flow. The results show that an unstable flow structure composed by a water falling film, a bubbly mixture, a water ascending film appearing alternately in riser pipe dominates the performance of airlift pump at large air flow rates. The bubbly mixture with a strongest capacity for pumping water first increases to its maximum and then slightly decreases. In suction pipe, the average velocity shows a flat profile and increases with increasing submergence ratio. Moreover, the predicted results of modified model are in good agreement with the experimental data in a margin of ±12%.

Keywords: Pump; Gas-liquid flow; Mixtures; Flow structure; Riser pipe

1 Introduction

Airlift pump consists of a vertical pipe divided into two parts: suction pipe which is the part located between the air injection point and the bottom of the vertical pipe, riser pipe which is the part located between the air injection point and the top of the pipe. The main advantage of this pump is that it has no mechanical transmission and no necessary lubrication. Due to its simple construction, airlift pump is a low-cost tool for lifting corrosive, explosive and toxic materials in chemical industries [1] and is being used for other applications, including petroleum exploration,