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Fachun Liang, Yuan Sun, GuiYun Yang, Lianmin Song

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Gas-liquid two-phase flow rate measurement with a multi-nozzle sampling method

Fachun Liang, Yuan Sun, GuiYun Yang, Lianmin Song

College of Pipeline and Civil Engineering, China University of Petroleum, Qingdao 266580, China

Abstract: A novel sampling device is proposed to measure the gas-liquid two-phase flow rate based on Extracting and Separating Method (ESM). A small fraction of gas-liquid mixture is extracted from the main stream and the total gas and liquid flow rate are determined according to the flow rate of sampled fluid and the extraction ratio. The extraction ratio is determined by the ratio of sample nozzle number to the total splitting nozzle number. Experiments were carried out in an air-water two-phase flow loop, and the flow patterns occurred during the experiments were wavy flow, annular flow and slug flow. It was found that the gas and liquid extraction ratio were close to the theoretical value (0.25) and independent of flow patterns, gas and liquid velocities. The error of flow rates measurements was less than $\pm 5.0\%$.

Keywords: two-phase flow; flow metering; sample; flow pattern

1. Introduction

Gas-liquid two-phase flow is widely encountered in many branches of industry and the measurement of flow rate is of great importance. Due to the complexity of two-phase flow, the flow rate measurement is still a challenge. In the last few decades, different methods and devices for multiphase flow metering have been proposed [1-3]. Multiphase flow measurement alternative are primarily divided into four categories: separation type multiphase flow metering method, on-line multiphase flow metering method, virtual metering method and Extracting and Separating Method (ESM).

The separation type multiphase flow metering method is a conventional approach and still widely used today. First, the gas-liquid two-phase mixture is separated into distinctive phase using a two-phase separator. Then the flow rate of each phase is measured by corresponding single-phase flow meters. An example is gas-liquid cylindrical cyclone (GLCC) which has been studied and used in recent years[4]. Turkowski[5] used a simple modification of pipeline configuration rather than a separator to achieve this aim. The advantage of the separation type method is that the two phase metering process is simplified into single phase one and the

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