Modeling the pressure drop of wet gas in horizontal pipe

Peining Yu, Yi Li, Jing Wei, Ying Xu, Tao Zhang

PII: S1004-9541(16)30654-1
DOI: doi:10.1016/j.cjche.2016.10.024
Reference: CJCHE 725

To appear in:

Received date: 6 July 2016
Revised date: 22 September 2016
Accepted date: 11 October 2016

Please cite this article as: Peining Yu, Yi Li, Jing Wei, Ying Xu, Tao Zhang, Modeling the pressure drop of wet gas in horizontal pipe, (2016), doi:10.1016/j.cjche.2016.10.024

Fluid Dynamics and Transport Phenomena

Modeling the pressure drop of wet gas in horizontal pipe☆

Peining Yu, Yi Li*

Graduate School at Shenzhen, Tsinghua University, Shenzhen 518055, China

Jing Wei

CFHI Tianjin C-E Electrical Automation Co.Ltd, Tianjin 300457, China

Ying Xu, Tao Zhang

School of Electrical Engineering and Automation, Tianjin University, Tianjin 300072, China

ABSTRACT

A model for gas–liquid annular and stratified flow through a horizontal pipe is investigated, using the two-phase hydrokinetics theory. Taking into consideration the flow factors including the void fraction, the friction between the two phases and the entrainment in the gas core, the one-dimensional momentum equation for gas has been solved. The differential pressure of the wet gas between the two tapings in the straight pipe has been modeled in the pressure range of 0.1–0.8 MPa. In addition a more objective iteration approach to determine the local void fraction is proposed. Compared with the experimental data, more than 83% deviation of the test data distributed evenly within the band of ±10%. Since the model is less dependent on the specific empirical apparatus and data, it forms the foundation for further establishing a flow measurement model of wet gas which will produce fewer biases in results when it is extrapolated.

Keywords：gas-liquid flow; pressure drop; hydrodynamics; model

1. Introduction

As a specific subset of gas-liquid two-phase flow, wet gas widely exists in various manufacturing processes in industry. According to the definition of the technical report released by International Organization for Standards (ISO/TR11583)[1], wet gas refers to the two-phase flows of gas and liquid in which the flowing fluid mixture consists of gas in the region of more than 95% volume fraction. This definition is adopted in this study and all the experiment conditions were within this scope.

☆ Supported by the National Nature Science Foundation of China (61603207 and 61571252) and Tsinghua University Shenzhen Graduate School Grant (050100001).

* Corresponding author.
E-mail address: liyi@sz.tsinghua.edu.cn (Y. Li)