

Accepted Manuscript

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PII: S0920-4105(17)31028-8

DOI: [10.1016/j.petrol.2017.12.071](https://doi.org/10.1016/j.petrol.2017.12.071)

Reference: PETROL 4561

To appear in: *Journal of Petroleum Science and Engineering*

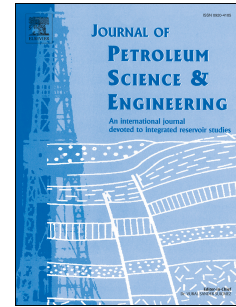
Received Date: 7 March 2017

Revised Date: 30 September 2017

Accepted Date: 21 December 2017

Please cite this article as: Archibong-Eso, A., Baba, Y., Aliyu, A., Zhao, Y., Yan, W., Yeung, H., On slug frequency in concurrent high viscosity liquid and gas flow, *Journal of Petroleum Science and Engineering* (2018), doi: 10.1016/j.petrol.2017.12.071.

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On Slug Frequency in Concurrent High Viscosity Liquid and Gas Flow

A. Archibong-Eso^{1,2,*}, Y. Baba^{1,3}, A. Aliyu^{1,4}, Y. Zhao^{1,5}, W. Yan^{1,5}, H. Yeung¹

¹Oil and Gas Engineering Centre, Cranfield University, Cranfield, UK

²Department of Mechanical Engineering, Cross River University of Technology, Calabar, Nigeria

³Department of Chemical/Petroleum Engineering, Afe Babalola University, Ado-Ekiti, Nigeria

⁴School of Mechanical Engineering, Pusan National University, 609-735, Busan, Republic of Korea

⁵KW Limited, PETROFAC Group, Guildford, Surrey, United Kingdom

*Corresponding Author: a.e.archibong@cranfield.ac.uk; archibong.eso@gmail.com

ABSTRACT

Slug frequency is an important input parameter in most mechanistic and semi-mechanistic models used for estimating slug flow characteristics such as pressure gradient, slug length and slug holdup. It is also essential in the design and sizing of transport and/or production pipelines, process flow control, design and operation of process equipment, etc. This study experimentally investigates slug frequency in two horizontal pipelines with internal diameters (ID) of 0.0254 and 0.0764 m. Test liquids used in the study were mineral oil (with viscosity ranging from 1.0 – 4.0 Poise) and water while compressed air is the gas phase. Effects of liquid viscosity, gas superficial velocity, liquid superficial velocity, pipe internal diameter, pipe length and pressure gradient are discussed. Results indicate that slug frequency increased with increase in oil viscosity; decreased with increase in pipe diameter; and reduces along the length of the pipe. For gas Reynolds number, $Re_{SG} \leq 2500$, slug frequency increased with increase in gas superficial velocity, when $Re_{SG} > 2500$, slug frequency decreased with increase in gas superficial velocity. A new slug frequency correlation that accounts for liquid viscosity and gas superficial velocity, hitherto not included in other correlations was proposed. A comparative analysis of the proposed models and existing slug frequency correlation on a high viscosity databank showed that the proposed correlation gave the best prediction with an average absolute percentage error (AAPE) of 19.91%.

Keywords: Multiphase Flow, Slug Frequency, Slug Holdup, Slug Film, Heavy Oil, Pressure Gradient

1 Introduction

Multiphase flow of liquid and gas is a common occurrence in nuclear, food, chemical and the oil & gas industries. Slug flow is one of the most encountered multiphase

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