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A Study of High Viscosity Oil-Gas Slug Flow Using Gamma Densitometer

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Abstract : Experimental study of high viscosity oil-gas flows in horizontal pipelines published in literature has indicated that hydrodynamic slug flow is the dominant flow pattern observed. Investigations have shown that hydrodynamic slugging brings about high instabilities in pressure that can damage production facilities thereby making it inherent to study high viscous slug flow regime so as to improve the understanding of its flow dynamics. Most slug flow models used in the petroleum industry for the design of pipelines together with their closure relationships were formulated based on observations of low viscosity liquid-gas flows. New experimental investigations and data are therefore required to validate these models. In cases where these models underperform, improving upon or building new predictive models and correlations will also depend on the new experimental dataset and further understanding of the flow dynamics in high viscous oil-gas flows. In this study conducted at the Flow laboratory, Oil and Gas Engineering Centre of Cranfield University, slug flow variables such as pressure gradient, mean liquid holdup, frequency and slug length for oil viscosity ranging from 1..0 – 5.5 Pa.s are experimentally investigated and analysed. The study was carried out in a 0.076m ID pipe, two fast sampling gamma densitometer and pressure transducers (differential and point) were used to obtain experimental measurements. Comparison of the measured slug flow parameters to the existing slug flow prediction models available in the literature showed disagreement with high viscosity experimental data thus highlighting the importance of building new predictive models and correlations.

Keywords : gamma densitometer, mean liquid holdup, pressure gradient, slug frequency and slug length
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