Prediction of Pressure Gradient in Two and Three-Phase Flows in Vertical Pipes Using an Artificial Neural Network Model

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Abstract

The concurrent flow of gas with a mixture of oil and water is often observed in production tubing in the petroleum industry. Lack of physical understanding of the several phenomenological characteristics of three-phase flow can lead to unsatisfactory production rates or even oversizing of pipelines. Additional investigations to gain more insight and development of more accurate correlations for prediction of flow characteristics including pressure drop is necessary. In this study, an experimental study was conducted using air-water and air-water-oil mixtures in a 0.075m diameter pipe. Superficial gas and liquid velocities ranged from 0.03 to 0.13 m/s and 1.26 to 41.58 m/s respectively. Slug flow was the main flow pattern observed. In addition, the transition from churn to annular flow and annular were also observed. Due to the homogeneous nature of the oil-water-air mixture, the three-phase flow was evaluated as a pseudo-two-phase mixture. An Artificial Neural Network (ANN) model developed for the prediction of two-phase and three-phase pressure drop performed better than all models considered during the evaluation. Generally, it was found that the accuracies for pressure drop were considered adequate.

Keywords: artificial neural networks, two-phase flow, three-phase flow, pressure drop, vertical pipes

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