ABSTRACT

Majority of existing flow regime transition models do not identify the existence of plug and mist flows. Also, these models are applicable to either vertical or horizontal flow. Further, experimental data in literature show that the model of Taitel and Dukler (1976) under predict transition from stratified to annular flow. Present work aims at developing a unified flow regime transition model applicable to all inclination angles. The objectives of this study include: to improve transition from stratified to annular flow, to provide criteria for the existence of plug and mist flow, to develop new criteria for the existence of dispersed bubble flow, and to ensure consistent identification of flow regimes for inclination angles between horizontal and vertical. A modified model to Taitel and Dukler (1976) is proposed to identify transition from stratified to annular flow. A new flow dependent criterion is proposed for the existence of mist flow. Two models are proposed for the existence of plug flow. The first plug model is an exact criterion for the existence of bubble flow. The second plug model is based on experimental data published in literature. A new criterion for the existence of dispersed bubble is developed for vertical flow, and combined with Taitel and Dukler (1976) model for horizontal flow, to obtain a unified transition criterion for all inclination angles. Comparison with experimental data for stratified to annular flow show that present unified flow regime transition model accurately predict 83% of stratified flow, corresponding prediction of Taitel and Dukler (1976) model is lower at 73%. Present model accurately predict 84.6% of experimental data available in literature. First plug model identified 50% of experimental data, while second plug model identified all plug experimental data. Flow regime identification has been carried out for horizontal, vertical, and inclined flows at 30 degrees and 80 degrees, without discontinuities. The major significance of the present study is that better prediction of flow regime would result in application of flow regime specific mechanistic models for better prediction of pressure gradient and liquid holdup. Also, present flow regime transition model can be applied to all inclination angles.