

Procedure for Flow Regime Identification of Dispersed Bubbles in a Gas-Liquid Mixture Flowing in Vertical Pipes



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Introduction

- Gas-liquid flows are encountered in many industrial applications such as in the oil industry, where a gas-oil mixture is transported through pipes from the well to the separation and processing facilities.
- The dispersed bubbles flow is one of the several gas-liquid flow patterns frequently found in this industrial application.
- Depending on the dispersed bubbles flow regime (viscous, distorted and turbulent) (Ishii and Hibiki, 2006), the flow characteristics change significantly, influencing the gas velocity and, therefore, changing the gas fraction along the pipe cross section.

Aim

- The goal of this study is to propose a solution procedure for flow regime identification and consequently, obtaining the main characteristics of the dispersed flow.

Materials & Methods

- The solution procedure was implemented in a computer code written in Fortran 95 programming language.

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- For the results analysis, it was developed a computer code using Gnuplot application commands with the goal to generate a flow patterns map (Taitel et al., 1980) which allows viewing and verifying the occurrence of dispersed bubbles regimes.
- This analysis considered different work fluids (air-water; air-glycerin; gas-oil) as well as different pipe diameters (13 mm; 26 mm; 52 mm; 78 mm).

Results & Discussion

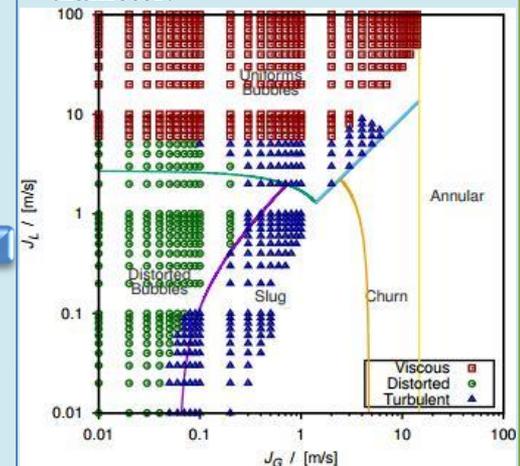
- The discrepancies found in the graphics' results, mainly due to changes in properties and diameter, are due to the fact that transition criteria adopted to regimes' identification and for building the flow pattern map are different, although they are based on some physical mechanisms similar nature.

Conclusion

- The analysis results showed that the solution procedure captures the dispersed flow characteristics with a good precision, despite of the differences encountered due to the variation of the fluids physical properties and the pipe diameter in the analyzed cases.

Graphs

- Solution procedure results for air-water flow in 26 mm pipe diameter.



References

- Taitel, Y., Barnea, D., & Dukler, A. E. (1980). Modelling flow pattern transitions for steady upward gas-liquid flow in vertical tubes. *AIChE Journal*, 26(3), 345-354.
- Ishii, M., & Hibiki, T. (2006). *Thermo-fluid dynamics of two-phase flows*.