FLUID MECHANICS LABORATORY D.P. MARGARIS, Professor

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COMPUTATIONAL AND EXPERIMENTAL INVESTIGATION OF TWO-PHASE AIR-WATER FLOW IN A 60º TILTED BRANCH OF A T-JUNCTION TYPE SEPARATOR WITH CIRCULAR CROSS-SECTION PIPELINE

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Abstract

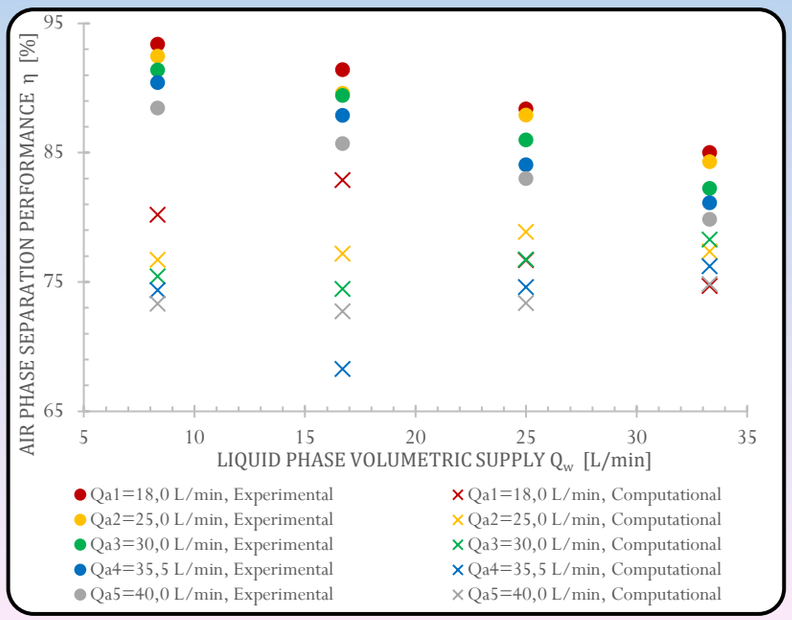
This diploma thesis deals with the computational and experimental investigation of two-phase air-water flow in a T-junction separator tilted at 60º. The results of sizes involved in the separation of two-phase air-water flow, such as the separation performance, the pressure gradient, the void fraction, the water carryover and the velocity and pressure gradient before and after the T-junction, results that obtained from the computational simulation or from the experimental process or calculated from theoretical models on a case-by-case basis are compared with each other to the conduct of safe and valid conclusions, as these are verified by both the numerical resolution and the physics underlying the phenomenon. Furthermore, developing flow regimes and phase distribution are visualized and compared with those predicting via theoretical regime maps for two-phase flows.

Separation Performance

The separation performance η (%) is given by the equation:

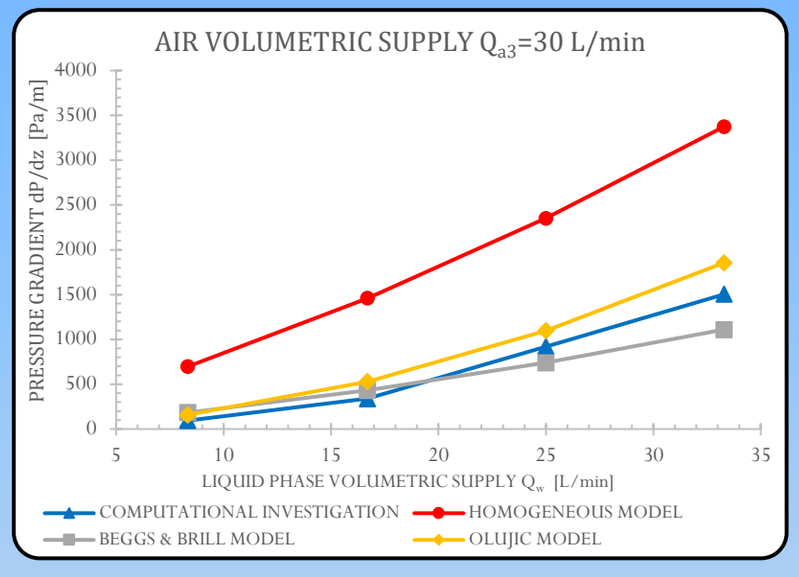
$$\eta = \frac{\dot{m}_{air\_branch\_outlet}}{\dot{m}_{air\_inlet}} \cdot 100\%$$

Comparative diagram of computational and experimental results for all cases.



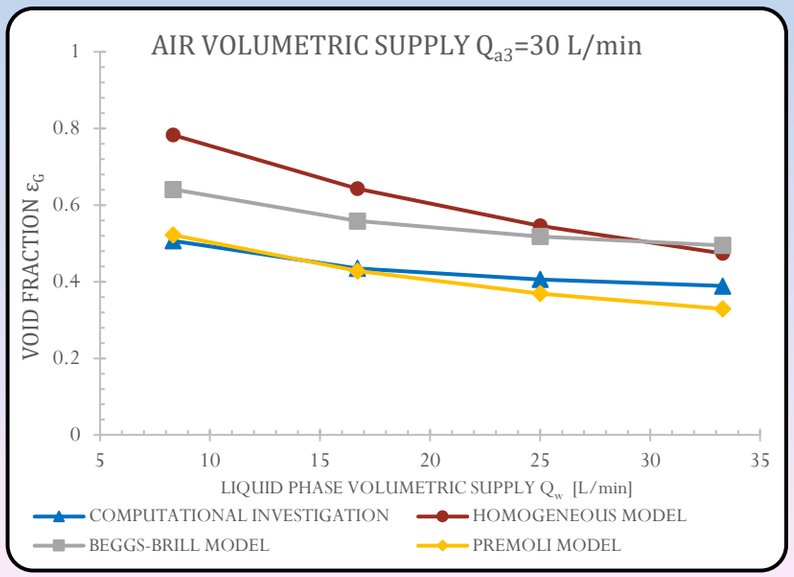
Pressure Gradient

The pressure gradient is calculated with 3 empirical models (homogeneous model, Beggs-Brill model and Olujic model) and compares with the results from the computational simulation.

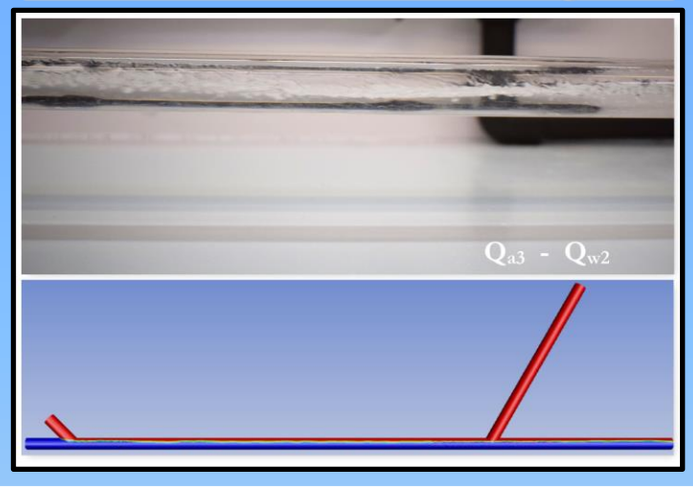


Void Fraction

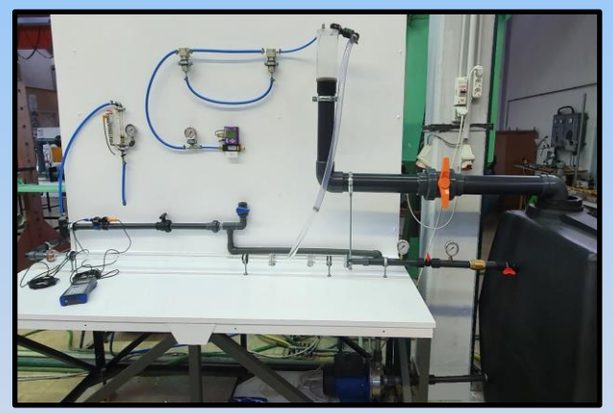
The void fraction is calculated with 3 empirical models (homogeneous model, Beggs-Brill model and Premoli model) and compares with the results from the computational simulation.



Phase Distribution-Flow Regimes



Experimental Pipeline Layout



Conclusions

- **Separation Performance:** The separation performance is slightly reduced mainly by increasing the water supply and almost negligible by increasing the air supply.
- **Pressure Gradient:** The pressure gradient increases by increasing both water and air supplies.
- **Void Fraction:** The void fraction decreases with the increase in water supply and increases with the increase in air supply.
- Changing the orientation, reducing the diameter of the side conductor and combining two or more type-T branches in sequence increases the final separation performance of the pipeline layout.