11th SEMINAR GROUP FLOW MULTIPHASE
Scientific Initiation Project

Project perforated pipe for inverted shroud

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Motivation

- Increase the efficiency of the inverted shroud and avoid the phenomenon of drowning occurs.
Introduction

- Simple modeling of the phenomenon using Homogeneous Model.
- Project criteria to obtain the number of holes:
  
  Annular pressure drop = Pressure drop through the holes.

\[
\frac{\partial P}{\partial x}_{\text{annular}} = f_m \frac{1}{2} \frac{1}{D_h} \rho_m J^2 + \rho_m g \sin \theta
\]

\[
\frac{\partial P}{\partial x}_{\text{holes}} = f_m l \frac{1}{2} \frac{1}{d} \rho_m V^2
\]
Introduction

- Development of a more realistic phenomenological model:
  - Expansion of the gas phase;
  - Non-linear drop pressure along the flow;

- Hypotheses:
  - Homogeneous model;
  - Steady state;
  - Air as a perfect gas;
  - Incompressible fluid;
Introduction

- Solving a non-homogeneous ODE via the numerical Runge-Kutta fourth order method:

\[ \frac{d}{dx} (P + \rho_m J^2) = -\tau_w - \rho_m g \sin \theta \]
Initial results

- Similar behavior between the two models developed for greater slopes:
  - For the project studied, the term of gravitational pressure loss is much higher than the term of the pressure loss due to friction;
The experiment

- The points of drowning were obtained only in inclination of 15 ° to the horizontal;
- For the most critical case (water flow rate of 238.98 l/min and air flow of 11.97 l/min) 96 holes of 5 mm diameter were obtained.
The experiment

- Two PVC pipes of 1.5 m length, each containing 48 holes of diameter 5mm;
The experiment

- Arrangement of the tubes in the separator:
Experimental results

- Comparative analysis:

<table>
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<th></th>
<th>Water flow (l/min)</th>
<th>Efficiency (%)</th>
<th>Lnai (m)</th>
<th>Uncertainty Efficiency (%)</th>
<th>Drowning</th>
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</tbody>
</table>
Next Steps

- Develop a model for more viscous fluids (example: oil-air flow).
Thank you for the attention!

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