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GAS-SOLID FLOW SIMULATION IN A VENTURI SCRUBBER

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ABSTRACT

For removing particles from a gas stream, scrubbing by a liquid spray is one of the most effective. In particular, venturi scrubbers are amongst the most efficient and effective of such devices.

Computational Fluid Dynamics emerged as a technique which can be successfully applied to solve multiphase flow problems. In this study, a computational model for a multiphase flow in a venturi scrubber has been developed using Fluent 6.2 version, which uses the finite volume method, to solve the conservation equations.

The single phase flow model has been modified to introduce a second phase in a Eulerian-Lagrangean approach. The air flow is considered incompressible Newtonian in steady state and turbulent. The turbulence was modelled by the k-ε standard method. Solid particles were considered as an approximation for the dispersed water phase.

Experimental data for pressure drop taken in a circular small scale venturi scrubber with a circular cross section was used to validate the model. The data have already been used by Teixeira [1] to validate other numerical models.

For the domain discretization flow symmetry is assumed along the cross sections of the scrubber. Hence only one-fourth of the scrubber volume is modelled. The resulting grid is defined using an available built package – Gambit 2.2.30 coupled with the Hexahedral/Wedge Cooper mesh generation algorithm. The 3D final mesh presents 7062 hexahedral elements (Figure 1).

The solid particles used are the aluminium oxide silica with a range of 10 to 210 μm in diameter and density of 2450 kg/m^3. The air mass flows tested are 0.005 and 0.0071 kg/s and the loading ratio is between 0.79 and 5.159.

Data for the experimental pressure drop in the throat section and the total pressure drop are compared with the numerical results in Figure 2.

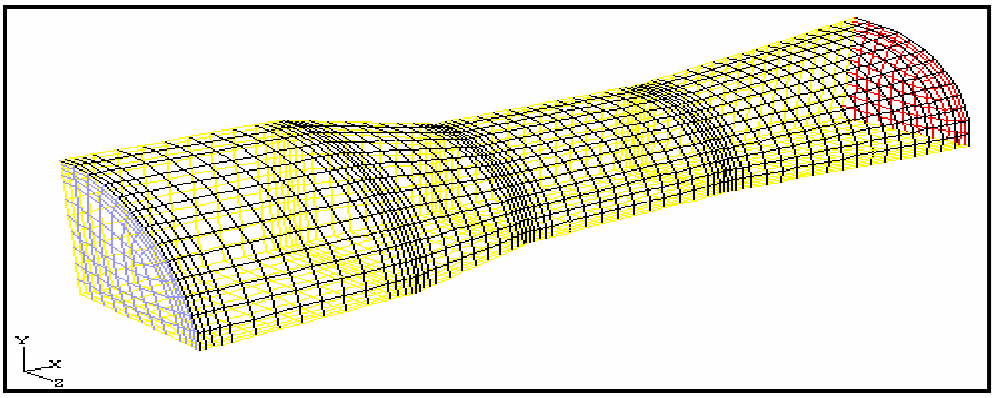

Figure 1 – Computational grid for the domain in GAMBIT.

The numerical values at wall are presented and the results present excellent agreement.

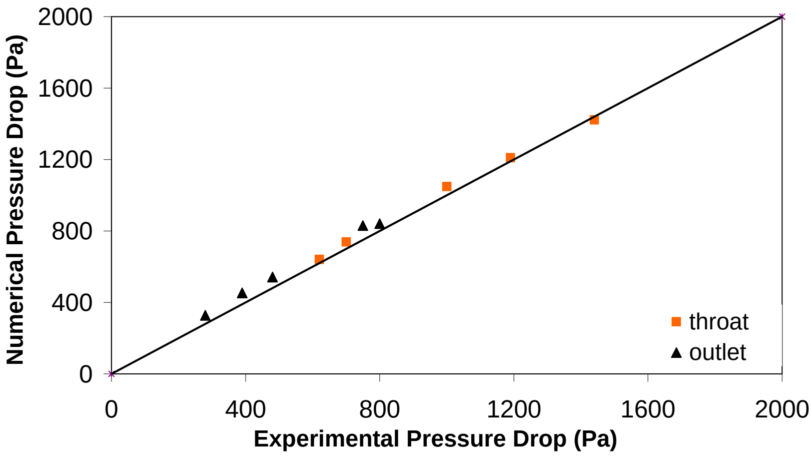

Figure 2 – Predicted vs experimental pressure drop.

The loading ratio (z) effect on the gas flow has been studied and results are compared in Figure 3.

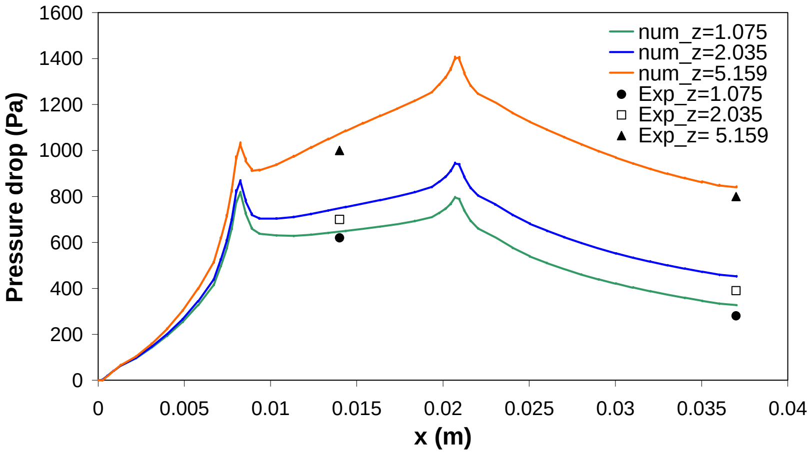

Figure 3 – Loading effect on the pressure drop along the venturi.

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