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Summary of:

EFFECT OF CO-FLOW VELOCITY RATIO ON EVOLUTION OF POLY-DISPERSE PARTICLES IN COAXIAL TURBULENT JETS: A LARGE-EDDY SIMULATION STUDY

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Effect of co-flow velocity ratio on evolution of poly-disperse particles in coaxial turbulent jets: A large-eddy simulation study

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Large-Eddy Simulation is carried out to study the poly-dispersed flow characteristics in a turbulent jet with varying co-flow velocity ratio and particle sizes. The particles considered here are rigid i.e; there is no breakup or evaporation of the particles throughout the flow. The central jet and the annular jets have a cylindrical cross section of the same diameter. The numerical simulation is carried out using OPENFoam by using the PIMPLEFoam for the single-phase jet, while employing MPPICFoam for multiphase. For injecting the particles into the jet, Rosin-Rammler distribution is used. The literature review focuses on giving a comparative understanding of why LES is computationally efficient than RANS model in order to simulate particle laden flows by citing the accuracy of the solution based on the previous works. LES uses Sub Grid Scales (SGS) to model the effect of small-scale eddies making the simulation more accurate. This paper is focused on the statistical measurement of the trends because the turbulence is inhomogeneous and this turbulent behavior evolves downstream of the sprays.

A co-flow velocity ratio (α) defined as the ratio of the maximum velocity of the annular jet to the central jet is introduced, which is one of the major parameters in this study. The simulation is carried out for $\alpha = 0,1,1.5$ and the smallest particle-size class is $25 - 50\ \mu m$ while the larger particles are of $50 - 75\ \mu m$ while the largest particles size measure $75 - 100\ \mu m$. The single phase jet $(\alpha = 0)$ follows the velocity decay pattern in the centerline similar to that of the round jet whereas for $\alpha \geq 0$, the velocity decay rate is lesser and there is mixing od the jets as the result of the shear layer of the annular jet approaching the central jet. As we go downstream, the centerline velocity is increased overall and the smaller particles matches nearly the average flow velocity of the gas.

In a co-flow condition, the turbulent intensity always increasing downstream and so, the large-eddy timescale-based Stokes number (St_l) is found to be smaller in a co-flowing condition due to the additional shear layer that is due to the interaction of the gas and liquid layer. Also, St_l is higher for $\alpha = 0$ and lesser for the cases with $\alpha \geq 1$.

The particles are dispersed when they exit the nozzle so, the centerline average particle number density decreases with the flow. But this number density is found to be higher for the cases of co-flows. Away from the nozzle exit, the number density of the larger particles is more than that of the smaller particles. Furthermore, a *Preferential Particle Accumulation Effect* is observed for the case when $St_l \approx 1$ when occurs in a co-flow with the particle's response time is nearly the same as the large eddy time scale.

This work briefs about the axial evolution of the particle size in all these three cases. The simulation result indicates that for any α and axial location, the Sauter Mean Diameter (SMD) is always higher than the Average Mean Diameter (AMD). While the value of SMD remains nearly constant the value of AMD is seen to be increasing based on the $Fig\ (22)$.

This paper presents a parametric study of the particle dispersion while comparing the experimental data for various cases for the LES model the authors have employed.