Solid Particle Dispersion in a Turbulent Jet

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Turbulent jets laden by solid particles form a class of interesting and applicative flow conditions as in spray, combustion as well as in cooling devices. As a matter of fact, unladen turbulent jet configurations have been extensively investigated over the years, whereas the complex interactions occurring among carrier and dispersed phase and the resulting effects on flow structure and particle dynamics are still an open field. A perspective on such subject[1] identified several parameters governing inter-phase interactions, the most relevant being the Stokes number, the particle Reynolds number, the ratio of particle to Kolmogorov length scales and the ratio of particle to fluid densities. A comprehensive study considering all these parameters would present a high degree of complexity, so that it is more reasonable and efficient focusing on a limited subset of variables. In this work, the attention is focused on the experimental investigation of the behavior of dispersed solid particles of different materials in a turbulent round jet, specifically on the role of the particle to fluid density ratio, from 0.7 to 19.3. The jet velocity field in the near-field region is derived by using Particle Image Velocimetry, in presence of only one material at a time. An example of derived fields is given in Figure 1, where the average axial velocity fields of each material are compared to the unladen jet condition. Particle-to-fluid density ratio is observed to have a strong impact on particle velocity field and turbulent fluctuations especially within the jet core, as related to the measured highest concentrations of particles.

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[1] Balachandar and Eaton, *Annu. Rev. Fluid Mech.* **42**, 111–133 (2010).

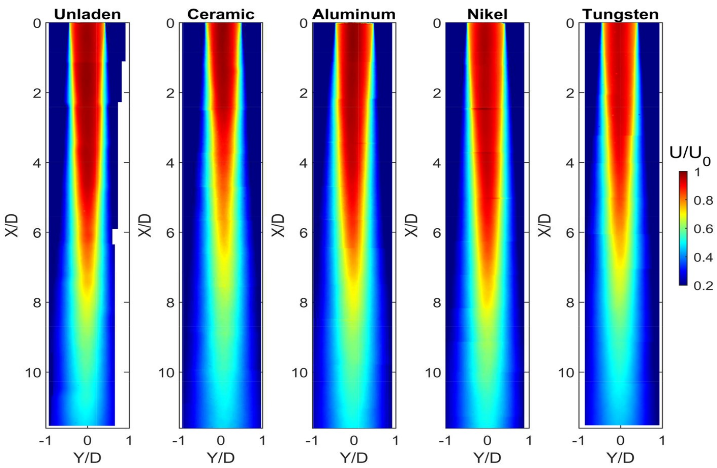

Figure 1: Comparison between average jet axial velocity for increasing particle to fluid density ratio: unladen and with ceramic (0.7), aluminium (2.7), nickel (8.9) and tungsten (19.3) particles.