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The physics of mixing and reaction of co-axial and cross-flow jets with disparate viscosity MUSTAFA USTA, GOKUL PATHIKONDA, CAMERON AHMAD, Georgia Institute of Technology, IRFAN KHAN, The Dow Chemical Company, DEVESH RANJAN, CYRUS AIDUN, Georgia Institute of Technology, THE DOW CHEMICAL COMPANY TEAM, GEORGIA INSTITUTE OF TECHNOLOGY TEAM — Mixing of miscible fast reacting liquids with disparate viscosity in a co-axial jet or jet in cross-flow is of great interest in several important industrial applications. Higher reaction rates turn the problem into mixing limited reactions. Computational analysis and experimental diagnostics of such a system are both challenging due to spatial and temporal scale separation. In this study, we use Particle-image Velocimetry (PIV) and Planar Laser induced Fluorescence (PLIF) imaging to measure the velocity field and mixture fraction, in conjunction with large-eddy simulation (LES) to investigate the details of the effect of large viscosity ratio on reaction yields. At high viscosity ratios the inner jet is turbulent, the outer jet is laminar and the downstream flow in the pipe appears to be 'fully developed' laminar flow. In this case, it is shown that folded segregated patterns in mixture fraction persist far downstream despite the flow being fully developed where mixing is primarily through diffusion and not convection. The experimental and LES results for the mixture fraction and reaction yields in the range of viscosity ratios from 0.3 to 250 will be presented. Furthermore, the unique mixing structure in this flow will be explained with gradient diffusion hypothesis.

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