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An advection-diffusion model for the dispersion in quasi two-dimensional steady turbulent jets JULIEN R. LANDEL, C.P. CAULFIELD, DAMTP & BPI, University of Cambridge, ANDREW W. WOODS, BPI, University of Cambridge — The study of turbulent jets in relatively enclosed geometries is relevant to many chemical engineering processes. Predicting the concentration of chemical reactants in time and space requires a good understanding of the jet dynamics. We have considered experimentally and theoretically the behaviour of liquid jets in a quasi-Hele-Shaw cell, where the jets are constrained in a narrow gap whose width is two orders of magnitude smaller than the length-scales of the other two flow dimensions. In this configuration, the dynamics shown by the jets is very rich. Detailed examinations of instantaneous structures of the flow reveal a high-speed sinuous core at the centre of the jet and large vortical structures on each side, which we analyse quantitatively using a variety of techniques (particle image velocimetry and dye experiments). These structures have a large impact on the mixing and dispersion properties of the jet. We propose a one-dimensional advection-diffusion model to account for the vertical dispersion in the jet. The diffusion coefficient assumed in the model is based on our understanding of the large-scale structures of these jets. The model is solved analytically using a similarity form in the case of a finite-volume release of tracers in the jet. The theoretical predictions and the experimental measurements show very good agreement.

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