

Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

The Effect of Aspect Ratio on Taylor Dispersion in Oscillatory Poiseuille Flow in Rectangular Channels JINKEE LEE, ELEJDIS KULLA, ANUBHAV TRIPATHI, Brown University, ANUJ CHAUHAN, University of Florida — The presence of size walls is known to lead to significant increase in dispersion in uniaxial Poiseuille flows even for very large aspect ratios. This presentation focuses on exploring the effect of the side walls on dispersion in oscillatory Poiseuille flows in rectangular channels. The method of multiple time scales with regular expansions is utilized to obtain analytical expressions for the effective dispersivity D_{3D}^* and analytical results are compared with CFD simulations. The effective dispersivity is of the form $D_{3D}^* = Pe^2 f(\Omega, Sc, \chi)$ where its dependency on the dimensionless oscillating frequency Ω , the Schmidt number and the aspect ratio χ of the channels is non-explicit. The effect of various parameters on dispersion coefficient is explored numerically and also through asymptotic expressions that are valid in some limiting cases. For small Ω the dispersion coefficient for the oscillatory flow approaches the time averaged dispersion of the unidirectional Poiseuille flow and for large Ω , D_{3D}^* scales as Pe^2/Ω^2 . We believe that the results of this study will enhance our understanding of transport in microscale systems that are subjected to oscillating flows.

Jinkee Lee
Brown University

Date submitted: 05 Aug 2010

Electronic form version 1.4