

Turbulent Flow and Transport

9 Dispersion in Pipe and Channel flow

9.1 Dispersion in laminar pipe flow. Purely diffusive dispersion, purely convective dispersion, and Taylor (or Taylor–Aris) dispersion. Scaling laws that define the conditions under which the various types of dispersion occur. Radial concentration distribution and effective axial diffusivity for Taylor dispersion in laminar flow.

9.2 Dispersion in a turbulent pipe flow. Effective axial diffusivity.
Comparison of Taylor dispersion in laminar and turbulent flows.

9.3 Dispersion in turbulent open–channel flows (see Monin & Yaglom Vol. 1, and Fischer).

Selected References:

Taylor, G. I. *Proc. Roy. Soc. A.*: **219** (1953): 186–203 (Laminar).
223 (1954): 446–468 (Turbulent).
225 (1954): 473–477.
Proc. Phys. Soc.: **67**, 12–B (1955): 857–869.

Aris, R. *Proc. Roy. Soc. A.*: **235** (1956): 67–77.

Probstein, R. F. *Physicochemical Hydrodynamics*. 2nd ed. Wiley, 1994.
(For laminar flow only, but follows the methodology used in 2.273—see p. 87 and p. 93.)

Monin & Yaglom, *Statistical Fluid Mechanics*. Vol. 1. MIT, 1973:
617–627, p. 627 ff. for channel flow.

Levich. *Physicochemical Hydrodynamics*. Prentice Hall, 1962: 116–120.

Fischer, H. B. "Longitudinal dispersion and turbulent mixing in open–channel flow." *Ann. Rev. Fluid Mech.*, Vol. 5 (1973): 59–78.

Chatwin, P. C., and P. J. Sullivan. *J. Fluid Mech.*, **120** (1982):347–358.

Smith, R. *J. Fluid Mech.*, **215** (1990):195–207.