
Contribution ID: **169** Type: **Poster Presentation**

# A Correlation for Dispersion Coefficient in Pipe Flows

*Tuesday, 23 May 2023 10:30 (1h 30m)*

Mixing occurs when two miscible fluids are brought into contact. Dispersion is a homogenized manifestation of the mixing process, which averages velocity and concentration fluctuations that cannot be resolved at the scale of observation. Shear dispersion, the process of solute spreading in pipe flow, originates from the non-uniform velocity profile in a pore cross-section. Taylor dispersion is the asymptotic limit of shear dispersion, i.e., when the pipe is long enough.
In the limit of long times, Taylor [1] derived the advection–dispersion equation for the cross-sectionally averaged concentration with an effective dispersion coefficient. This effective dispersion coefficient is analytically given as a function of Pe, where $Pe=UR/D_m$ is the Péclet number expressed in terms of the mean velocity U, tube radius R, and molecular diffusion coefficient $D_m$. For a tube of finite length, the dispersion exhibits the pre-asymptotic behavior, where the dispersion coefficient, defined by the temporal derivative of the mean square displacement of tracers, increases with flow time and eventually converges to the Taylor dispersion coefficient. There are numerous studies that seek to find the early-time solution for dispersion in straight tubes. However, due to the difficulties of theoretical analysis, most of the studies focused on tubes of circular cross-sections [2]. Since the cross-section of pore structures is highly irregular, it is difficult to upscale these pore-scale studies to the porous media scale.
In this study, we propose a correlation of dispersion coefficient in tubes of different cross-sections. The proposed correlation relates the dispersion coefficient to Pe and flow time. The present study can be easily combined with other simulation methods, such as pore network models, for upscaling the pore-scale shear dispersion to porous media scale.

## Participation

In-Person

## References

[1] G. I. Taylor, Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences 219, 186 (1953).
[2] E. Taghizadeh, F. J. Valdés-Parada, and B. D. Wood, Journal of Fluid Mechanics 889 (2020).

## MDPI Energies Student Poster Award

Yes, I would like to submit this presentation into the student poster award.

## Country

China

## Acceptance of the Terms & Conditions

Click here to agree

## Energy Transition Focused Abstracts

**Primary author:** Dr LIU, Yang

**Co-authors:** Dr GONG, Wenbo; Prof. WANG, Moran

**Presenter:** Dr LIU, Yang

**Session Classification:** Poster

**Track Classification:** (MS08) Mixing, dispersion and reaction processes across scales in heterogeneous and fractured media