Chemical Reaction Engineering-Beyond the Fundamentals
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MODULE 3.2
AXIAL AND RADIAL DISPERSION

OBJECTIVE

After the completion of this module, you will be able to

- Compare and contrast axial and radial dispersion phenomena
- Relate the hydrodynamics to diffusion and rate processes
- Articulate the physical significance of the dispersion phenomena

COMPUTE

- Using COMSOL, design a PFR for a hypothetical first order reaction $-r_A=k[A]$. The flow is laminar and velocity profile is parabolic, resulting in axial as well as radial dispersion. Choose your own design parameters. Plot $\bar{t}k$ versus conversion. Compare your findings with a reactor with no axial dispersion. Play with the axial dispersion coefficient to see how it influences the conversion for a first order reaction.
- Repeat the same calculations for a hypothetical second order reaction.
- Add a recycle stream to your reactor. Choose your own recycle ratio. How did the recycling changed the conversion in a reactor with axial dispersion?
- How does the velocity profile influence the extent of the axial dispersion and the extent of the radial dispersion?
- What other parameters play a role in radial dispersion?

SELF TEST QUESTIONS

Check your conceptual understanding by answering the following questions:

- What is axial dispersion?
- How does it influence the operation of a tubular reactor?
- Can we call a tubular reactor a PFR if axial dispersion is a persistent phenomenon?
- How is axial dispersion related to diffusion?

- List at least 10 reasons for the existence of axial dispersion in a reactor

- List at least 10 engineering solutions to the axial dispersion problem