

POD 27 : Lecture Review

Lecture 22
p. 307-325

- Taylor-Aris Dispersion
- key problem of difⁿ from a point dist
 - Variance grows as $2Dt$
 - Diffusion cuts of Taylor disp. by sampling dif. streamlines
 - random walk simulation $(2D \Delta t)^{1/2}$

Lecture 23
p. 326-340

- Concentration Polarization and FFF
- accum (Convection) to wall balanced by difⁿ leads to exponential profile w/ D/u_0 length
 - Shear flow w/ polarization leads to Taylor dispersivity
 - combination of dif. length scales due to difⁿ leads to separation in AF4 device
 - Number of theoretical plates / resolution balance between sep. & dispersion

Lecture 24
p. 341-355

- Conc. Polarization on Rotating membranes
- centrifugal force leads to radial (and axial) flow in rotating system
 - boundary layer thickness indep. of position
 - transient conc. polarization in dead end filtration

Lect. 25 Cross-flow Filtration

- p. 356-369
- spiral wound membrane used in RO systems
 - energy cost is $Q_F P_F$ less recovered pressure
 - optimal recovery ratio RR
 - K_M relatively unimportant for seawater (high π_{osm}) (good enough) - but matters if π_{osm} is lower
 - hollow fiber mass transfer resistance
 - diffusion time scales in kidney dialysis

Lec. 26 Elementary Electrostatics

- p. 370-383
- It's all about the Debye layer thickness κ^{-1}
 - polarization charge increases capacitance of a dielectric
 - net free charge is confined to a diffuse layer, preserving electroneutrality
 - ion conc. governed by Boltzmann eqⁿ, relates surface potential to charge dist.

Lec 27 Electrodynamics

- p. 384-397
- tangential field leads to electroosmosis.
 - EO velocity yields a flat profile prop. to ψ_s
 - Tangential field also causes electrophoresis and the combination is used in capillary elect.
 - curved channels lead to dispersion
 - convection leads to streaming potential and membrane charging.