Heterogeneous reaction

Solid catalyst with fluid reactant B -->catalyst Products

B does not significantly react unless in contact with the catalyst

What affects reaction rates?

* Phases
* Surface area/geometry of reactants
* Flow of reactants
* Reaction mechanism kinetics

In - Out = Accumulation + Reaction

Flux = mass/area\*time

(Flux)Area|in = (Flux)Area|out + Accumulation + Reaction

Flux can come from bulk flow or diffusion

(u\*C - D dC/dx)Area|in = (u\*C - D dC/dx)Area|out + V\*dC/dt + V\*f(c)

1. No reaction, no accumulation
   * (u\*C - D dC/dx)Area|in = (u\*C - D dC/dx)Area|out
2. No reaction, accumulation
   * (u\*C - D dC/dx)Area|in = (u\*C - D dC/dx)Area|out + V\*dC/dt
3. Reaction, steady state
   * (u\*C - D dC/dx)Area|in = (u\*C - D dC/dx)Area|out + V\*f(c)

No reaction

(-D dC/dx)A|x+Δx = (-D dC/dx)A|x + AΔx\*dC/dt

((D dC/dx)|x+Δx - (D dC/dx)|x)/Δx = dC/dt

Dd2C/dx2 = dC/dt

Assume the system is at steady state

Dd2C/dx2 = kC

Spherical coordinates: r, r+Δr

A = 4πr2

V = 4/3π(r+Δr)3 - 4/3πr3 = 4/3π(3r2Δr + 3rΔr2 + Δr3)

As Δr --> 0

V = 4π(r2Δr)

Flux = D dC/dr

(-D dC/dr)4πr2|r - (-D dC/dr)4πr2|r+Δr = V dC/dt

4πDr2dC/dr|r+Δr - 4πDr2dC/dr|r = 4πr2ΔrdC/dt

(Dr2dC/dr|r+Δr - Dr2dC/dr|r)/Δr = r2dC/dt

Ddr(r2dC/dr) = r2dC/dt

D(2rdC/dr + r2d2C/dr2) = r2dC/dt

D(2/r dC/dr + d2C/dr2) = dC/dt

Fluid-Particle Reaction Kinetics: Shrinking Core Models

A(g,l) + bB(s) --> P(s,l,g)