A + R --> R + R

-rA = kCACR = -dCA/dt

CA0 + CR0 = CA + CR = CT = C0

kCA(C0 - CA) = -dCA/dt



Useful for modeling fermentation reactions

What kind of reactor to use for these reactions?

PFR, MFR, or batch?

MFR at low product concentrations and PFR at high product concentrations.

At the maximum reaction rates: use MFR until the maximum reaction rate, then use PFR for the rest

**Reactor Combination**

CA0 --> MFR --> PFr --> CAF

How to find maximum reaction rate?

-d(1/r)/dC = 0

Assume second order reaction: -r = kC2

-d(r-1)/dr \* dr/dC = r-2dr/dC = 0

dr/dC = 0

A + R --> R + R

-rA = kCACR = -dCA/dt

CA0 = 0.99 mol/L

CR0 = 0.01 mol/L

CA = 0.1 mol/L

CR= 0.9 mol/L

K = 1 L/mol-min

1. What is τ (MFR)?

τ = CA0 - CA / kCACR

τ = 0.99 - 0.1 / (1 \* 0.1 \* 0.9)

τ = 0.89/0.09

τ = 9.889 min

1. What is τ (PFR)?

τ = ∫ dCA/kCACR

τ = ∫ dCA/kCA(1 -CA)

τ = 1/kCT \* ln(CA0(1-CA)/CA(1-CA0))

τ = 1/1\*1 ln(0.99/0.01)/(0.1/0.9)

τ = 6.792 min

1. What is minimum size of PFR, MFR combo to achieve reaction?

r = kCACP = kCA(C0-CA) = kCA(1-CA)

= kCA - kCA2

drA/dCA = k - 2kCA = 0

CA = 0.5 mol/L

τm = CA0 - CA / kCA(1-CA)

τm = 0.99 - 0.5 / k0.5(1-0.5)

τm = 0.49 / 1 \*0.5 \* 0.5

τm = 1.96 min

τp = 1/kCT \* ln(CA0(1-CA)/CA(1-CA0))

τp = 1/1 \* 1 \* ln(0.5(1-0.1)/0.1(1-0.5))

τp = ln(0.5\*0.9/0.5\*0.1)

τp = ln(0.45)/0.05)

τp = 2.2 min

τT = 1.96 + 2.2 min = 4.163 min