Autocatalytic Reactions

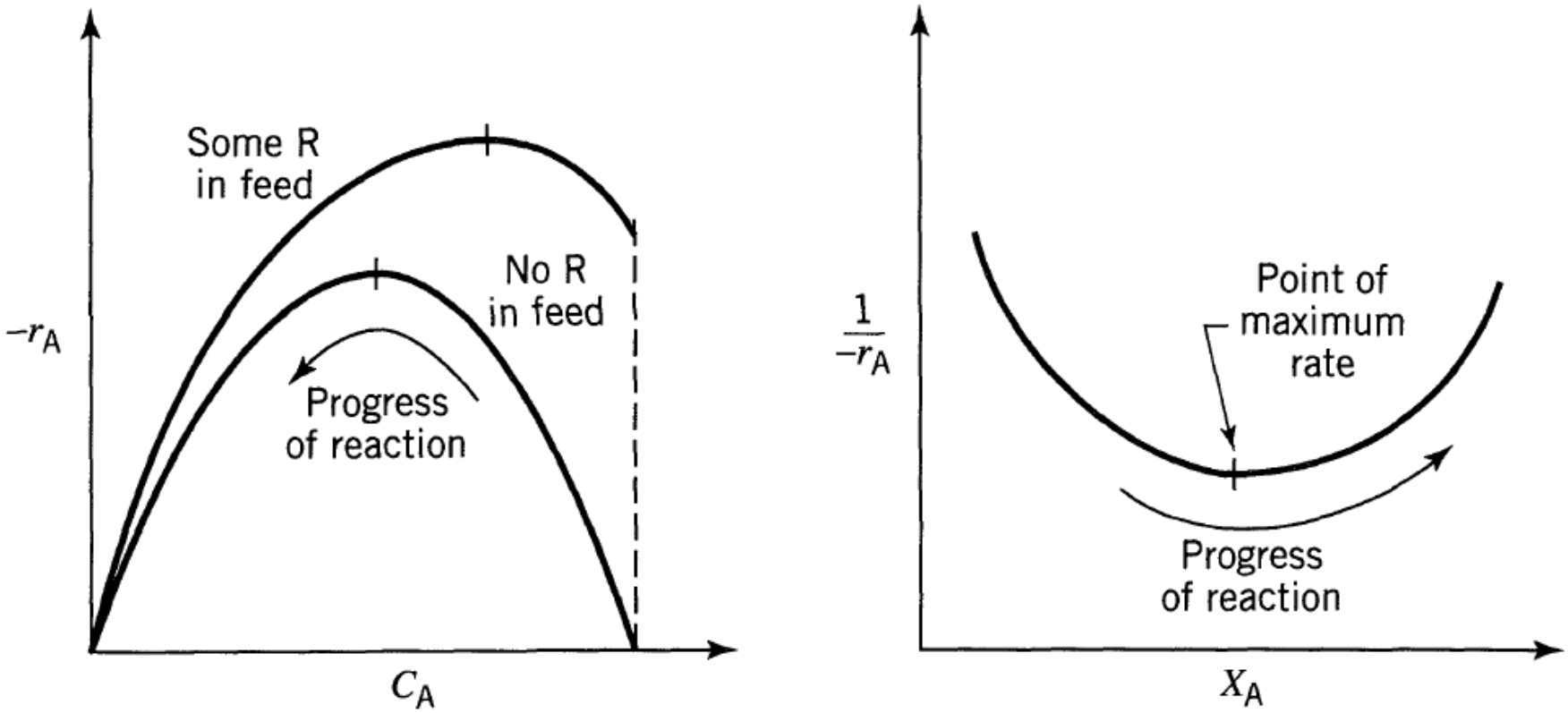


Figure 6.18 Typical rate-concentration curve for autocatalytic reactions, for example:

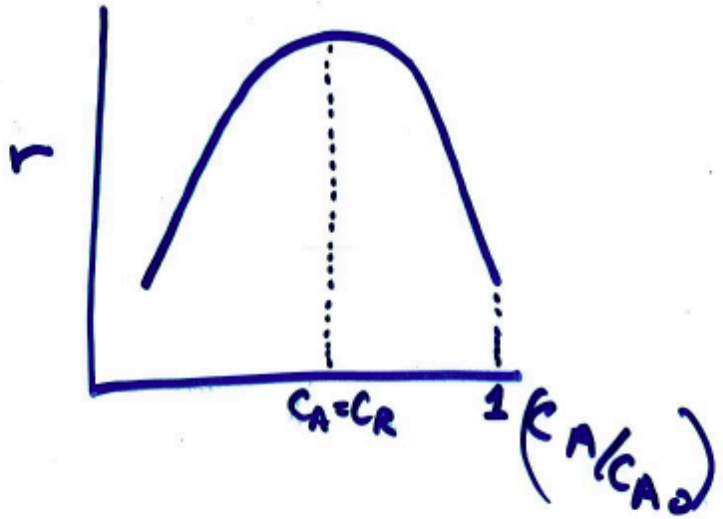
$$A + R \rightarrow R + R, \qquad -r_A = kC_A^a C_R^r$$

$$A + R \rightarrow R + R$$

- $$\frac{dC_A}{dt} = kC_AC_R = kC_A(C_0 - C_A)$$

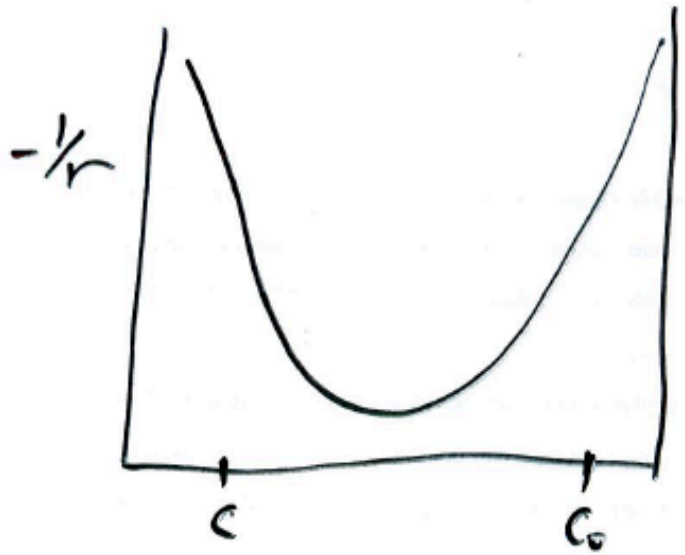
$C_0 = C_{A0} + C_{R0}$

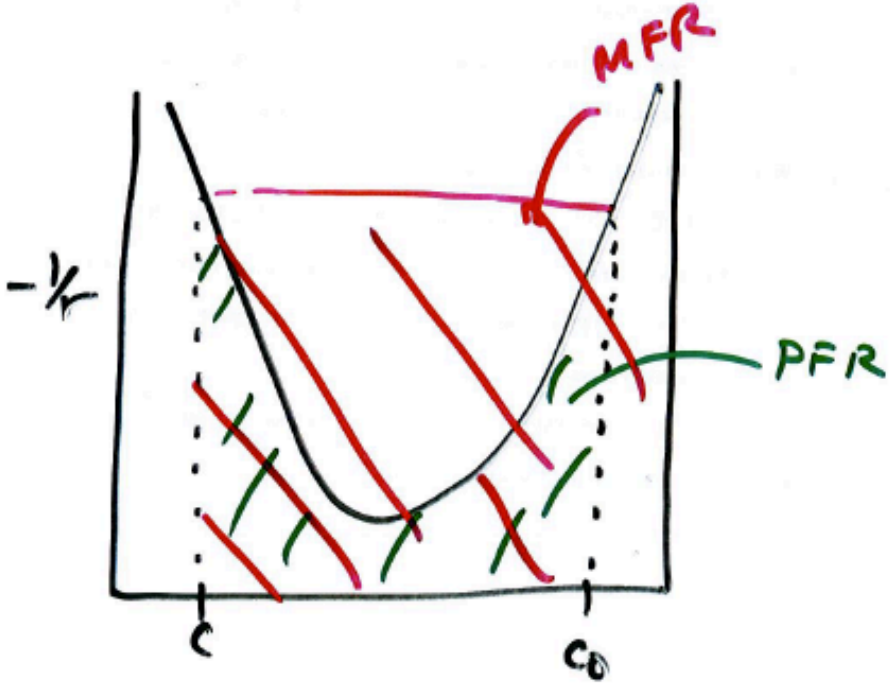
$$kt = \frac{1}{C_{A0} + C_{R0}} \ln\left[\frac{C_{A0}(C_0 - C_A)}{C_A(C_0 - C_A)}\right]$$

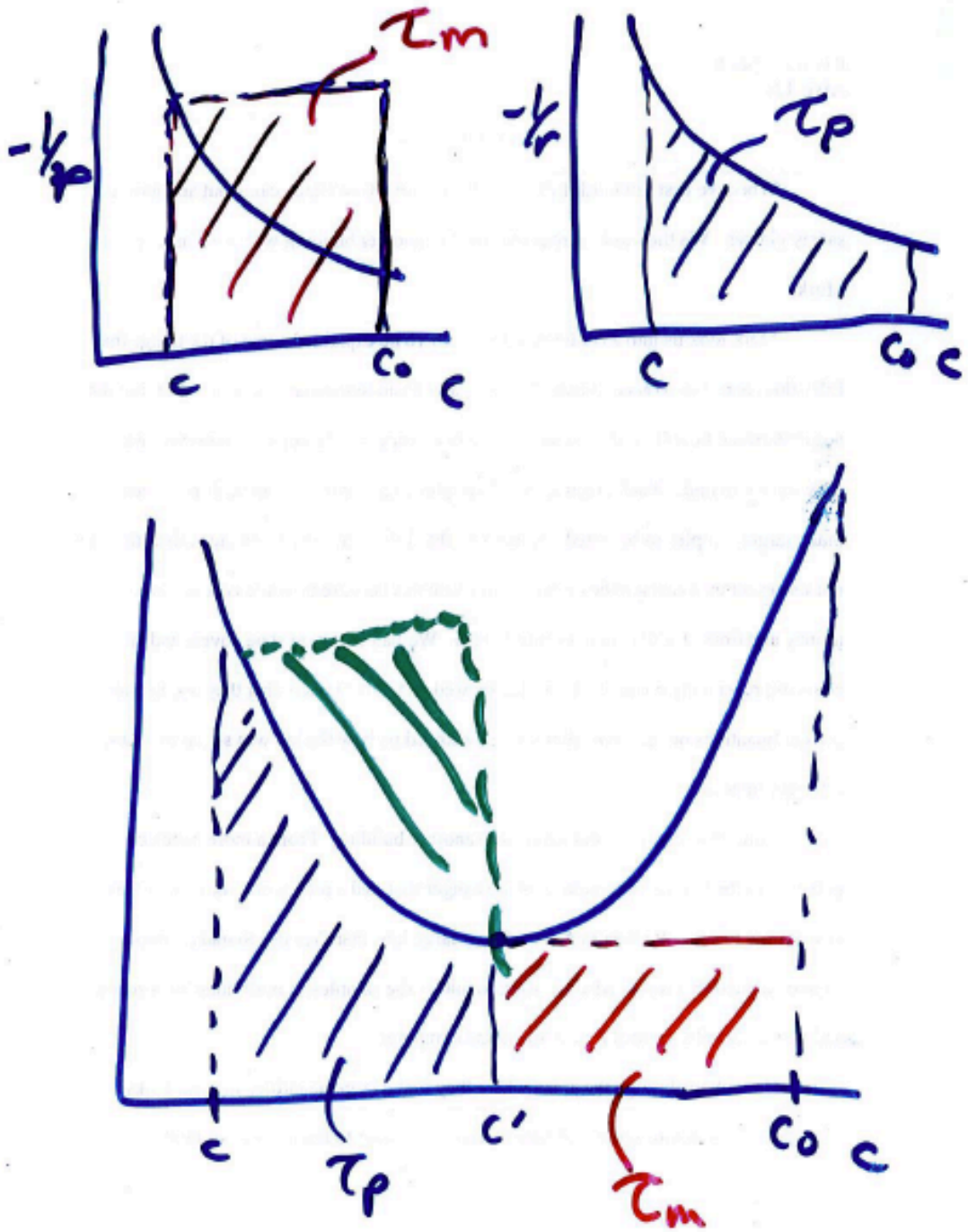


useful for modeling fermentation rxns

R = cell mass or 2nd'y product formation


-1/r
C
C0


MFR
PFR
-1/r
C
C0


τ_m
$-1/r_p$
c
c_0
c
$-1/r$
τ_p
c
c_0 c
c
τ_p
c'
τ_m
c_0 c

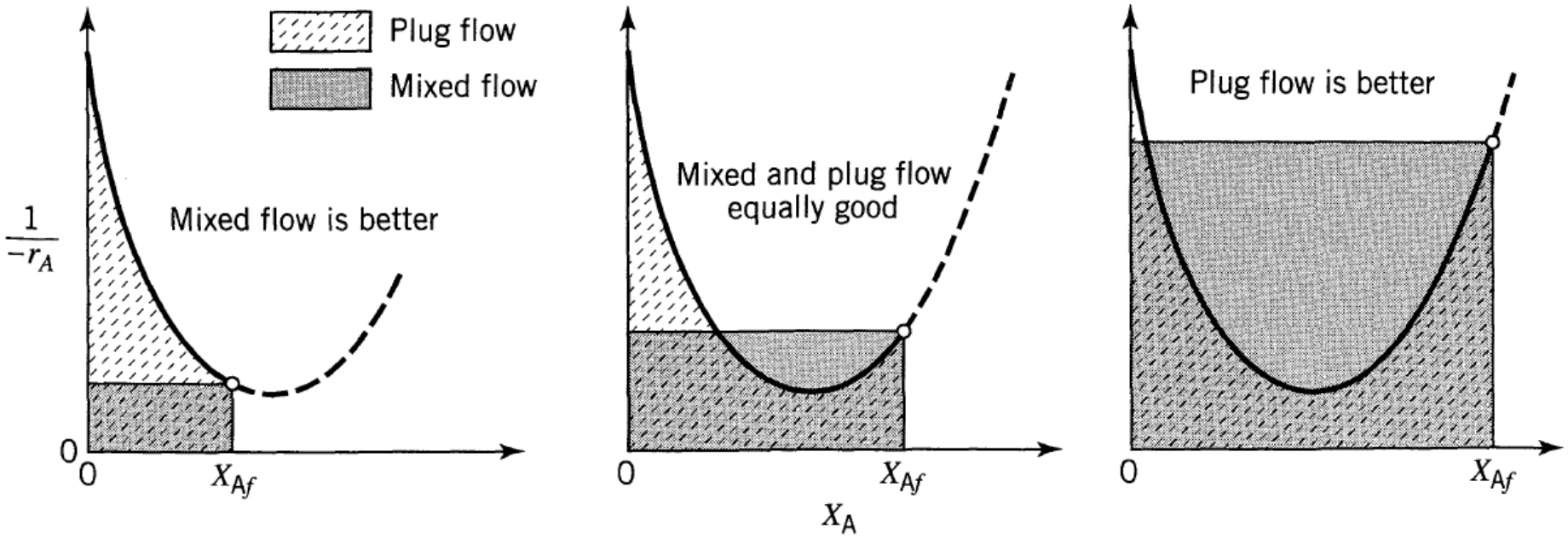
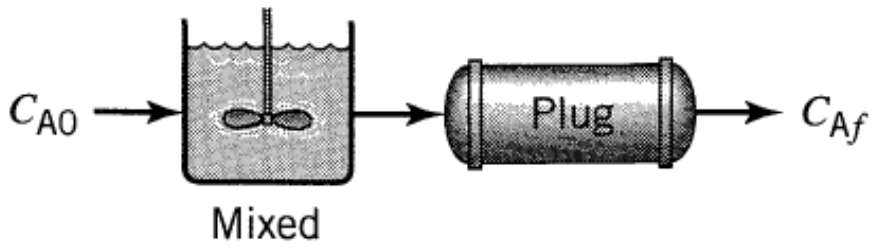
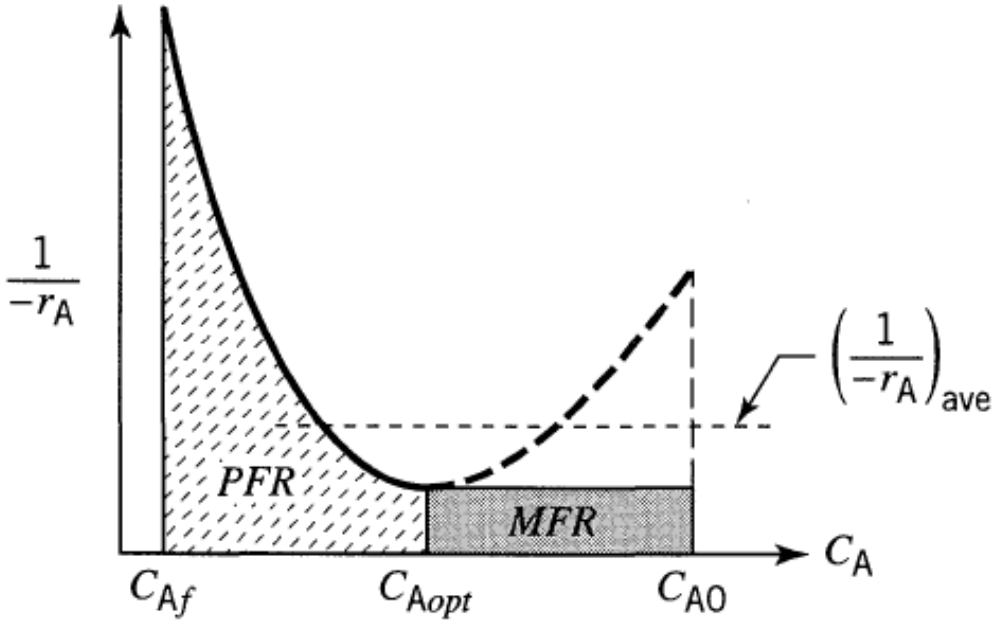


Figure 6.19 For autocatalytic reactions mixed flow is more efficient at low conversions, plug flow is more efficient at high conversions.

Reactor Combination





$A + P \rightarrow P + P$

$r = -k C_A C_P$

1) What is τ_m (mfr)?
2) What is τ_p (pfr)?
3) What is minimum size of pfr, mfr combo to achieve rxn?

$C_{A_0} = 0.99 \text{ mol/L}$

$C_{P_0} = 0.01 \text{ mol/L}$

$C_A = 0.10 \text{ mol/L}$

$C_P = 0.9 \text{ mol/L}$

$k = 1 \frac{L}{\text{mol-min}}$