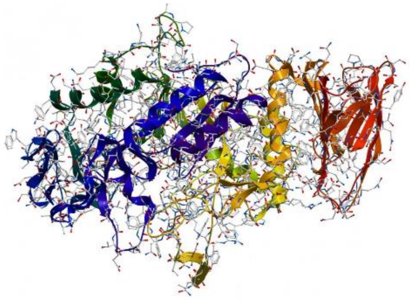


CEN-CHE 422
ENZYME ENGINEERING

ENZYME REACTORS-1

CLASSIFICATION OF ENZYME REACTORS

Operation Modes:

✓**Batch**
✓**Continuous**
✓**Fed-batch**

Hydrodynamics :

✓**Back-mixed**
✓**Plug Flow**

Phases:

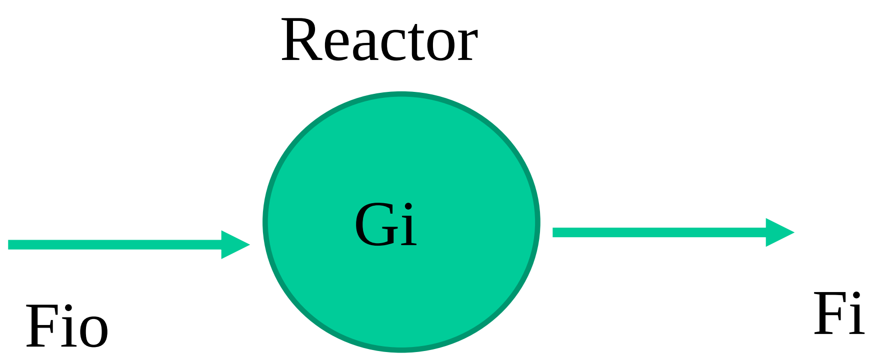
✓**2-phase reactors (Stirred-tank; Bubble column, Packed-bed reactors)**
✓**3-phase reactors (Stirred tank, Trickle bed, Fludized bed**

Parameters affecting the reactor selection

- ✓ **Manufacturing and operating expenses of the reactor (substrate, separation processes, labor)**
- ✓ **Reaction kinetics**
- ✓ **Enzyme type (free or immobilized)**
- ✓ **Characteristics of the immobilization matrix, pH and temperature control, enzyme, substrate and product stability during operation**

MATERIAL BALANCE IN ENZYME REACTORS

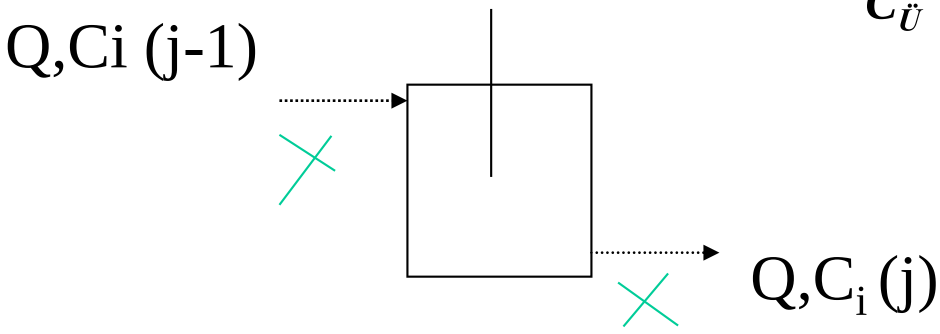
Isotherm conditions

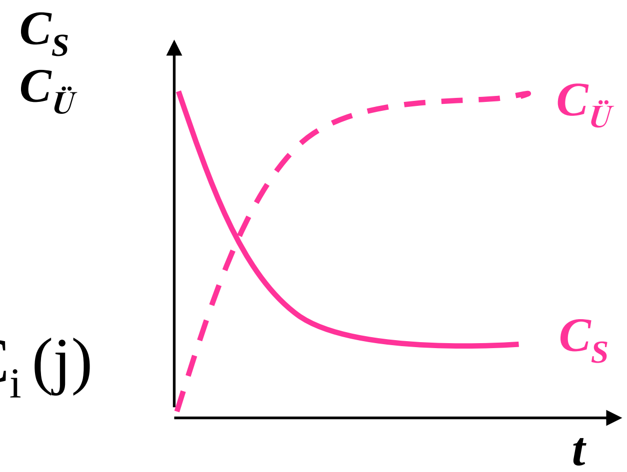


Rate of flow of *i* *into* the system (moles/time) + Rate of *generation of i* by chemical reaction within the system (moles/time) - Rate of flow of *i* *out* of the system (moles/time) = Rate of *accumulation of i* within the system (moles/time)

$$F_{io}\text{-}F_i + G_i = \frac{dNi}{dt}$$

Batch Enzyme Reactor Mass Balance:





$$QC_{i(j-1)} - QC_{i(j)} + r_i V_J = \frac{dN_{i(j)}}{dt}$$

$$QC_{i(j-1)} - QC_{i(j)} + r_i V_J = \frac{d(VC_i)_j}{dt}$$

i= component
J= reactor no
V= Reactor volume
Q= Volumetric flow rate
C= concentration
N=mole number

No input and output of reactants!

$$r_i V_J = V \frac{dC_{i(J)}}{dt}$$ Liquid phase reaction

$$r_i = \frac{dC_i}{dt}$$

for i=S and MM kinetics:

$$r_S = -\frac{dC_S}{dt} = -\frac{r_{\max} C_S}{K_m + C_S}$$

$$r_{max}dt = -\frac{(K_m + C_S)}{C_S}dC_S$$

$$r_{max}t = -\int_{Cso}^{Cs}\frac{K_m}{C_S}dC_S - \int_{Cso}^{Cs}dC_S$$

$$r_{max}t = -K_m \ln\frac{C_S}{C_{So}} - (C_S - C_{So})$$

$$r_{max}t = K_m \ln\frac{C_{So}}{C_S} + (C_{So} - C_S)$$

Time variation of substrate concentration in batch reactor