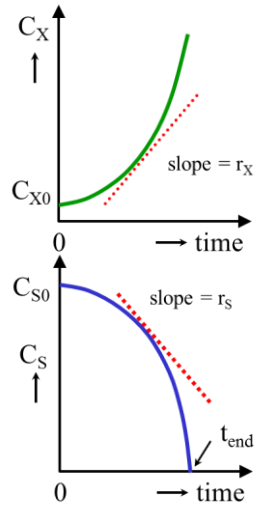
Bioprocesses → Bioreactors

Batch

$$C_x = C_{x0}\exp(\mu^{max} t)$$

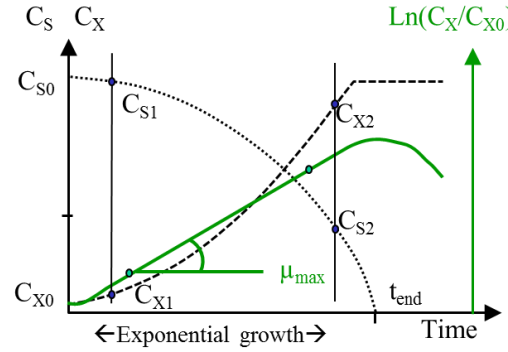
Parameters			state Variables
reactor	operator	micro-organism	
V	C_{S0} C_{X0}	q_S^{max} μ^{max} Y_{SX}^{max} m_S, K_S	C_S C_X



$$C_{S0} - C_S = \frac{q_S^{max}}{\mu^{max}} C_{X0}\left[\exp(\mu^{max} t) - 1\right]$$

$$\mu^{max} = \text{slope } \ln\left(C_x / C_{x0}\right)$$

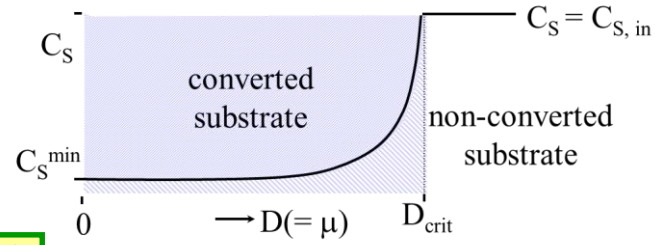
$$Y_{SX} \approx Y_{SX}^{max} = \frac{C_{X2} - C_{X1}}{C_{S1} - C_{S2}}$$



Chemostat

Parameters			state Variables
reactor	operator	micro-organism	
V $\phi_{L,out}$	$\phi_{L,in}$ $C_{S,in}$	q_S^{max} μ^{max} Y_{SX}^{max} m_S, K_S	C_S C_X

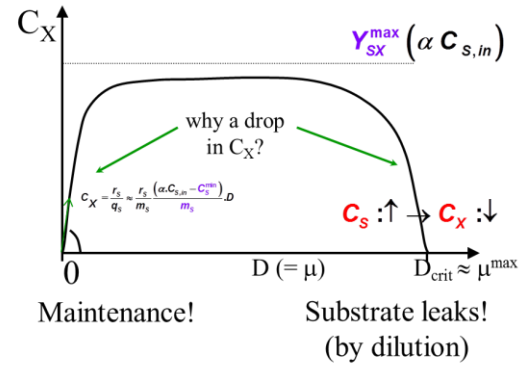
$$C_S = \frac{C_S^{min} + K_S \dfrac{D}{\mu^{max}}}{1 - \dfrac{D}{\mu^{max}}}$$



$$C_X = Y_{SX}\left(\alpha . C_{S,in} - C_S\right)$$

$$\mu = \frac{r_X}{C_X} = \frac{Q_{L,out}}{V} \overset{def}{=} D : \text{Dilution rate}$$

$$D_{crit} = \mu^{max} \cdot \frac{\left(C_{S,in} - C_S^{min}\right)}{K_S + C_{S,in}} \approx \mu^{max}$$



Lineweaver-Burk linearisation

$$\frac{1}{q_S} = \frac{k_S}{q_S^{max}}\frac{1}{C_S} + \frac{1}{q_S^{max}}$$

Hanes-Woolf linearisation

$$\frac{C_S}{q_S} = \frac{1}{q_S^{max}} . C_S + \frac{k_S}{q_S^{max}}$$

Hyperbolic equation $q_S = f(C_S)$