A quickie example. A wastewater with a flow of 1 MGD (3.78x10^6 L/dy) and a BOD\textsubscript{L} of 250 mg/L is to be treated in a CSTR to reduce the BOD to 30 mg/L. What size must the reactor be if the biological population has the following kinetic parameters: \( k = 8 \text{ mg BOD}_\text{L}/\text{mg cells} \times \text{day}, K_S = 10 \text{ mg/L}, Y= .6, \) and \( b = .05/\text{day} \)?

Solution: remember, \( S_0 \) is not important. We can set \( S \) in the effluent by control of \( \theta \).

\[
S = \frac{K_s(1 + b\theta)}{\theta(Yk - b) - 1}
\]

\[
30 \text{ mg/L} = \frac{(10 \text{ mg/L})(1 + .05 \theta)}{\theta \left( .6 \frac{\text{mg cells}}{\text{mg BOD}_\text{L}} \times 8 \frac{\text{mg BOD}_\text{L}}{\text{mg cells} \times \text{day}} - .05/\text{day} \right) - 1}
\]

Solving, \( \theta = .28 \text{ day} = \frac{V}{Q} \)

Therefore, \( V = \theta \times Q = .28 \text{ day} \times 10^6 \text{ gal/day} \)

\[
= 2.8 \times 10^5 \text{ gal. (or 1.06x10}^6 \text{L)}
\]