Lab 6: Fed Batch Growth

Fed-batch operation is employed for an organism producing a metabolite product in order to minimize glucose substrate inhibition. The specific growth rate of the organism has been shown to follow the following equation

$$\mu = \frac{\mu_{max} S}{Ks + S + S^2/KI}$$

If the kinetics of the organism are as follows

Y_{XS} = 0.5 g/g

Y_{XP} = 0.2 g/g

μ_{max} = 0.3 h^{-1}

Ks = 1 g/l

KI = 300 g^2/l

The starting reactor volume is 1000 ml containing 20 g of cell biomass. Glucose is fed at a rate of F_0 = 0.2 L/hr and concentration S_0 = 100 g/l.

a. Using the balances for cell biomass, substrate and product shown in class, obtain plots of S, X, P and μ over 20 hours of the fermentation. For substrate balance, neglect product and maintenance terms. The total product in the reactor at any time can be calculated by the following expression

$$\frac{dP^t}{dt} = \mu X V / Y^{XP} \quad and \; P = \frac{P^t}{V}$$

b. List the values of S and X after 20 hours of fermentation
c. Obtain expression for S, X, P and μ over 20 hours of fermentation using the quasi-steady state assumption for S and X.
d. Based on the results of a and b, comment on the validity of the quasi-state assumption.