Contacts: eveline.mayner@epfl.ch
manfred.zinn@epfl.ch

Biochemical Engineering
Exercise Session 6

1) Constant feed fed-batch

In a fed-batch culture of *Escherichia coli* operating with feed of a glucose solution, values of the following parameters are given at time t = 2 h, when the system is at quasi-steady state.

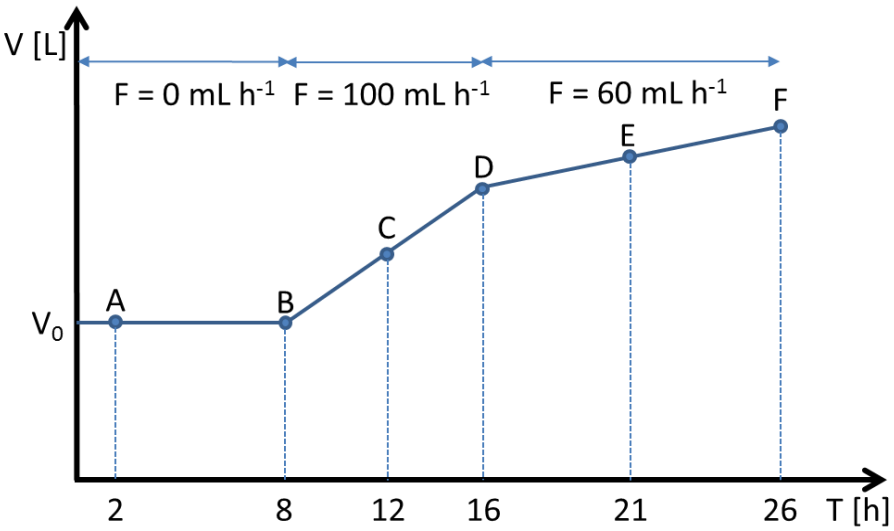
V = 1000 mL	dV/dt = 200 mL h^{-1}
s_0 = 100 g glucose L^{-1}	μ_{max} = 0.3 h^{-1}
K_s = 0.1 g gluscose L^{-1}	$Y_{X/S}$ = 0.5 g cells (g glucose)$^{-1}$
X_0 = 30 g (total = x_o^t)	

a) Find V_0 (the inital volume of the culture)
b) Determine the concentration of growth-limiting substrate in the vessel at quasi-steady state at t = 2 h.
c) Determine the concentration and total amount of biomass in the vessel at t = 2 h (at quasi-steady state)
d) If q_p = 0.2 g product (g cells)$^{-1}$ h^{-1}, p_O = 0, determine the concentration of product in the vessel at t = 2 h.

2) Design of a multi-phase fed-batch for the production of lipase

A fed-batch for the production of a lipase is carried out with a recombinant strain *Yarrowia lipolytica (see also figure below)*:
Phase 1: Batch on glucose (s_0 (Glucose) = 6 g L^{-1})
Phase 2: Fed-batch on glycerol Feed1 s_0 (Glyc) = 1260 g L^{-1}
Phase 3: Fed-batch on lactose with Feed2 s_0 (Lact) = 500 g L^{-1}.

Inoculum batch : X_0 = 0.1 g



Questions:
a) Calculate the culture volume of the bioreactor at times B, C, D, E, and F
Note: V_0 = A = 2.0 L

B : ……..C : …….. D : ……. E : …….. F : ……..

b) *Calculate the dilution rates for the time points A, C, and E.*

A: ……; C: ……; E: ……

c) Calculate the total biomasses for the time points B, D, and F.
Note: $Y_{X/Gluc}$ = 0.5 g g^{-1}, $Y_{X/Glyc}$ = 0.1 g g^{-1}, $Y_{X/Lact}$ = 0.3 g g^{-1}

B: ……; D: ……; F: ……

d) Calculate the concentration of lipase at the end of the fed-batch (time point F).
Note: $Y_{Lipase/X}$ (Glucose) = 0 g g^{-1}, $Y_{Lipase/Glyc}$ = 0.01 g g^{-1}, on lactate: $Y_{Lipase/X}$ = 0.5 g g^{-1}
F: ……

e) Calculate volumetric productivity of lipase and of the biomass for the *whole* bioprocess (time point F).

F: ……

3) Different feed profiles

Please complement the following figures with the trends you are expecting for the respective parameters for the following feed conditions:

1) Exponential feed; 2) Pulsed feed; 3) Constant feed

Note: Dashed line represents end of batch culture