Structured Model for PHB Production (PHB)

- Growth and storage of PHB are described as functions of limiting substrate S (NH_4^+), residual biomass R and product P (PHB) concentrations.

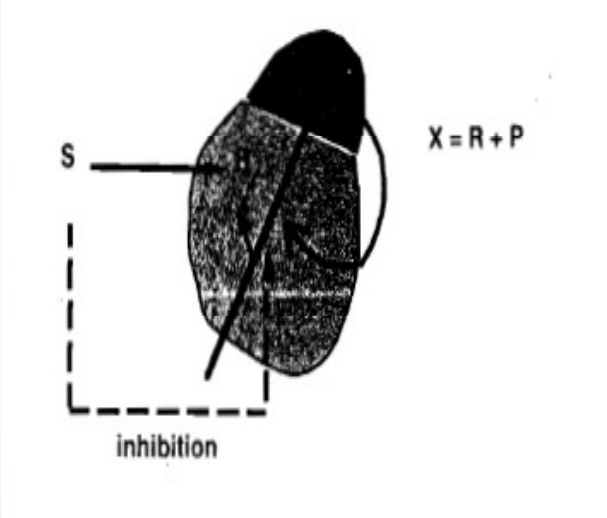


Fig. 7. Structured kinetic model for PHB synthesis.

PHB [Model]

- For the batch process,

$$\frac{dR}{dt} = r_R = \mu R$$

- Where rR is the rate of synthesis of R and μ is the specific rate of synthesis of R,where

$$\mu = \mu_1 + \mu_2 = \mu_{m,1}\frac{S}{K_{S,1} + S} + \mu_{m,2}\frac{(S/K_{S,2})^n}{1 + (S/K_{S,2})^n}$$

PHB [Model]

- For substrate

$$\frac{dS}{dt} = r_S = -\frac{1}{Y_{R/S}} r_R$$

- The rate of synthesis of P(r_P) is assumed to be the sum of a growth associated term($r_{P,1}$) and a biomass associated term($r_{P,2}$) and is given by,

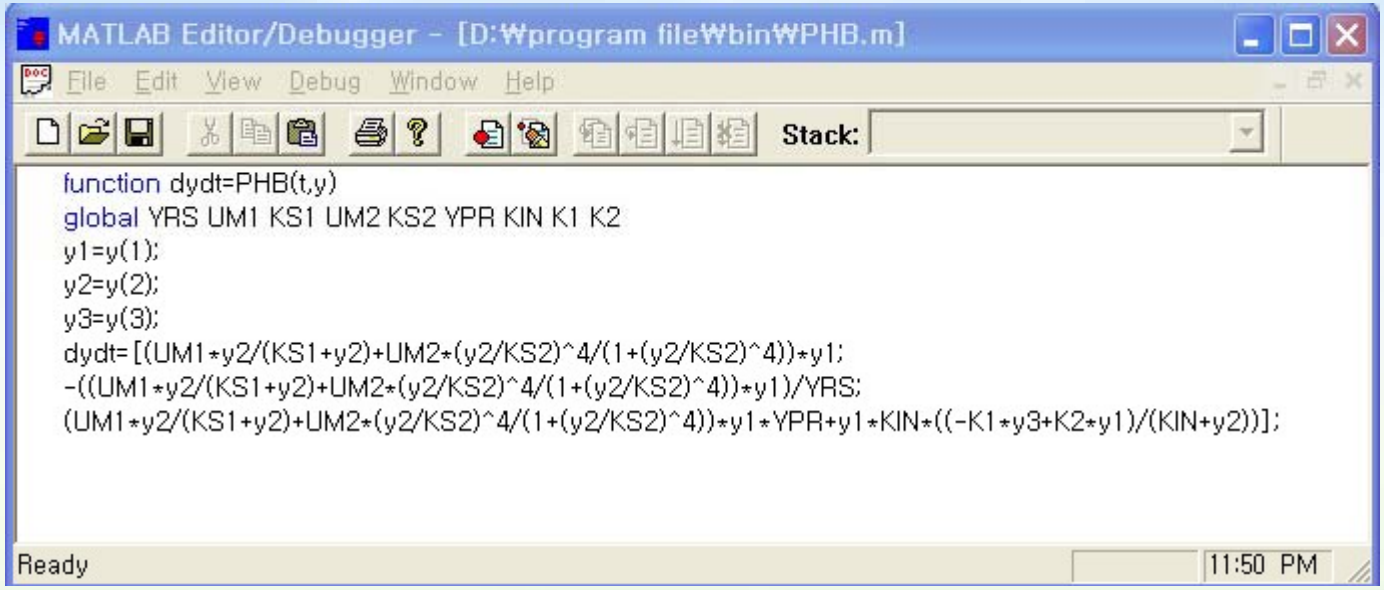
$$\frac{dP}{dt} = r = r_{P,1} + r_{P,2}$$

- The non-growth associated term of the synthesis of P($r_{P,2}$)

$$r_{P,2} = \frac{K_1}{(K_1 + S)}(-k_1 P + k_2 R)$$

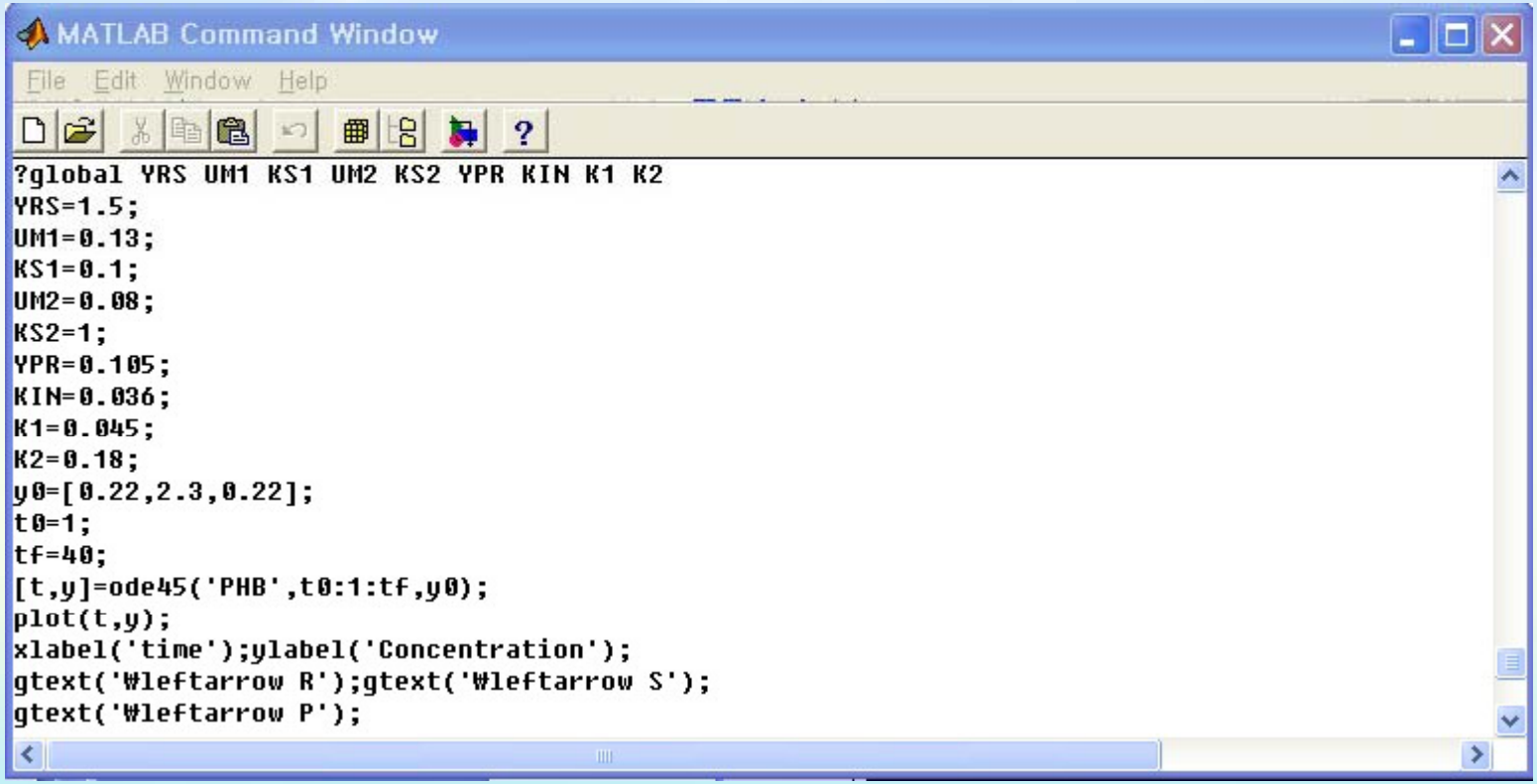
PHB [Program]

M-file



PHB [Program]

Command window



PHB [Nomenclature]

- C_1 Concentration kg/m_3
- K_1 Inhibition constant, for $(NH_4)_2SO_4$ kg/m_3
- K_S Saturation constant kg/m_3
- n Hill coefficient –
- P Product concentration (PHB) kg/m_3
- Prot Protein concentration kg/m_3
- R Residual biomass(R=X-P) kg/m_3
- r Reaction rate $kg/(m_3h)$
- $r_{P,red}$ Reduced rate of synthesis of PHB –
- S Limiting substrate NH_4+as $(NH_4)_2SO_4$ kg/m_3
- X Biomass concentration kg/m_3
- $Y_{P/R}$ Yield coefficient kg/kg
- $Y_{R/S}$ Yield coefficient kg/kg
- μ Specific rate of synthesis of R (r_R/R) 1/h
- μ_P Specific rate of synthesis of P (r_P/P) 1/h

PHB [Result]

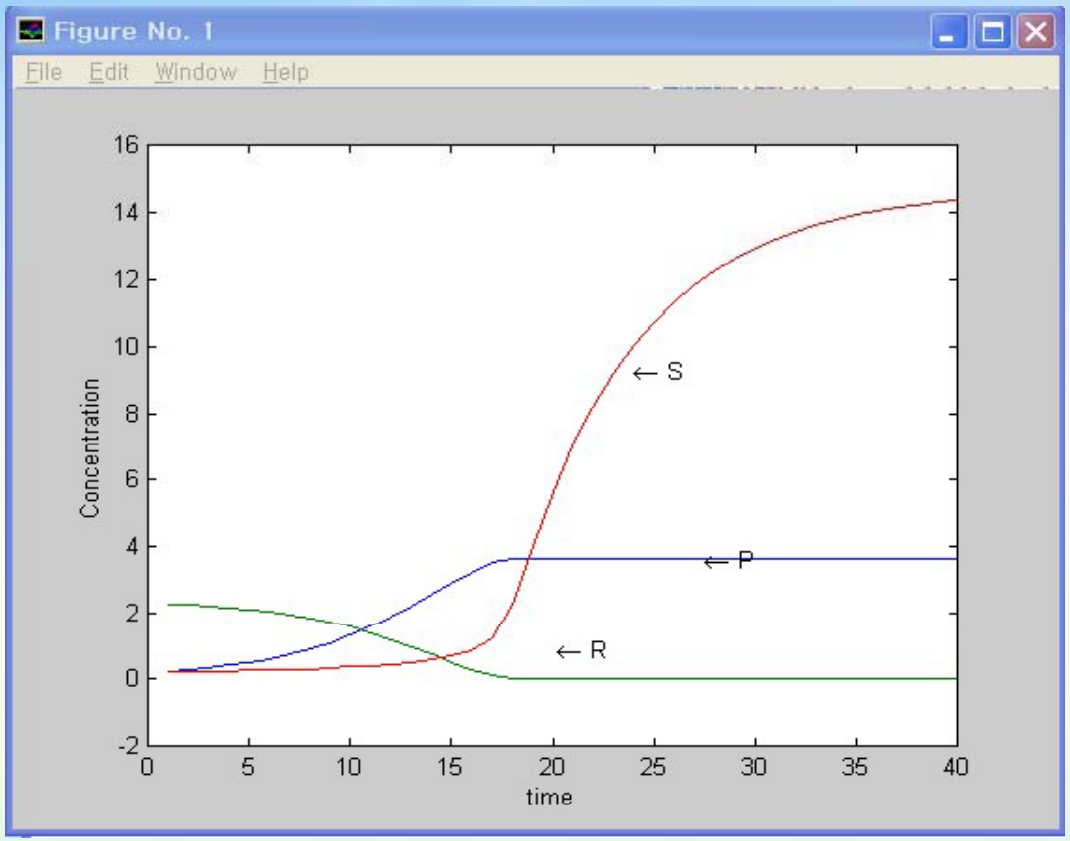


Fig. 8. Plots of R, S and P versus T during batch growth and production.