chemostat\_dyn

Dynamic simulation of start-up and control of a 10 L chemostat.

The process starts as a batch and initially the time scale is 0-19 hours.

When time exceeds 19 hours the scale is automatically extended to 0-200 hrs.

(You can change the scale 0-200 hrs on the first line in the algorithm.)

Click in the graph to interrupt and change the control parameters dilution rate (by F), inlet limiting substrate concentration (Si) or cell recirculation (delta).

Too high dilution rate will result in wash-out but the critical value depends on cell recirculation.

See Fermentation Process Eng. (www.enfors.eu) for further information.

The model does not represent a specific organism but corresponds approximately to

E. coli grown in a glycerol mineral salts medium without oxygen limitation.

Variables:

time h

X g/L Biomass conc.

S g/L Limiting substrate conc.

DOT % air sat Dissolved oxygen tension

F L/h Medium flow rate (plot variable)

my /h Specific growth rate

Slow g/L Limiting substrate conc. plotted with scale 0-0.5 g/L

Constants:

F L/h Medium flow rate (control variable for dilution rate)

Si g/L Inlet concentration of limiting S

delta - Cell recycling factor <=1 (1=no recycling)

qSmax g/g/h Max specific S consumption rate

Ks g/L Saturation constant for S

Yem g/g Biomass yield coefficient excl. maintenance

qm g/g/h Maintenance coefficient

Yosresp g/g Oxygen per substrate in respiration

DOTstar % DOT in equilibrium with air bubbles

H %/(g/L) Conversion DOT to gO2/L

Cs gC/gS Carbon content of limiting substrate

Cx gC/gX Carbon content of biomass

Ko % Saturation constant for DOT

KLa /h Vol. oxygen transfer coefficient

V L Medium volume

Algorithm:

if t<19;set(gca,'xlim',[0,20]);else; set(gca,'xlim',[0,150]);end%Change timescale at 19 hrs

qS=qSmax\*S/(S+Ks); Monod model for obl. aerobic metabolism

my=(qS-qm)\*Yem; Specific growth rate

qO=Yosresp\*(qS-my\*Cx/Cs); Specific respiration rate

if my<0;my=0;end Blocks possible numeric errors

dXdt=-F/V\*delta\*X+my\*X; Mass balance for X

dSdt=F/V\*(Si-S)-qS\*X; Mass balance for S

dDOTdt=KLa\*(DOTstar-DOT)-qO\*X\*H;Mass balance for DOT

Slow=S;

dydt=[dXdt;dSdt;dDOTdt]; Pack in column vector for ode23s