CHE507 Advanced Process Control

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Homework #1 (due before Dec.31st)

Consider the reactor described in the attachment. (Note that the unit for heat transfer coefficient should be U=75/60 But/(min-ft3-°F) for the consistency of the units).

1. Simulate the reactor by assuming the MV=fc (cooling water flow rate) and CV=T(reactor temperature), can be detected and manipulated by the controller (this can’t be true in the real case).
2. Get the reaction curve by a step change of cooling water flow rate from 0.8771 to 0.8 ft3/min as below:



1. Use the method of reaction curve to tune an
2. Optimal P-only controller
3. PI controller
4. PID controller
5. Compare the performance of the above three controllers and uncontrolled case.

Note controller gain Kc should be negative in this case.

function dy=reactor(t,y)

global dfc

V=13.26;k0=8.33e8;E=27820;R=1.987;thou=55;cp=0.88;dH=-12000;

%Unit of U should be in minutes not hour as in the text.

U=75/60;

A=36;Vc=1.56;cpc=1;thouc=62.4;%water

%steady states

Cai=0.5975;Ti=635;f=1.3364;Tci=540;fc=0.8771+dfc;

%vairables definitions

Ca=y(1);T=y(2);Tc=y(3);

%reaction rate

rA\_neg=k0\*exp(-E/(R\*T))\*Ca\*Ca;

%Material and Energy Balances

dy(1)=(f\*Cai-f\*Ca-V\*rA\_neg)/V;

dy(2)=(f\*thou\*cp\*Ti-f\*thou\*cp\*T-V\*rA\_neg\*dH-U\*A\*(T-Tc))/(V\*thou\*cp);

dy(3)=(fc\*thouc\*cpc\*Tci-fc\*thouc\*cpc\*Tc+U\*A\*(T-Tc))/(Vc\*thouc\*cpc);

dy=dy';

MATLAB statements

global dfc

dfc=-0.0771;

[t,y]=ode45('reactor',[0,50],[0.2068,678.9,602.7]);

plot(t,y(:,2))