Modelling and control summaries

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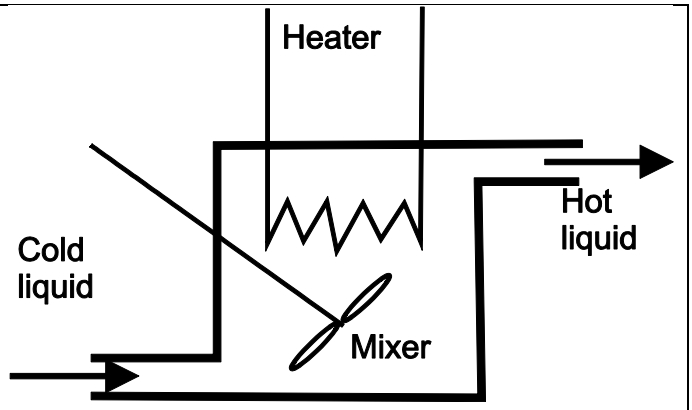
MATLAB GUIs – heat exchanger

ASSUMPTION: Students should understand the context of a simple heat exchanger.
In this example cold liquid is heated up by condensing steam (the heater) in a tank of volume V m^3. Assume perfect mixing.
Fluid (water) enters at one temperature (T_{in}) and leaves at another (T) and has constant flow rate F m^3/s.
It is assumed that the only heat supply is the latent heat $\lambda=2.3x10^6$ J/kg from the condensing steam which has flow rate Q kg/s.
C_p=4200J/degree is specific heat of fluid and $\rho=1000kgm^{-3}$ the density.



An approximate model for such a heat exchanger is given as:

$$\lambda Q + \rho F C_p T_{in} = \rho V C_p \frac{dT}{dt} + \rho F C_p T \quad \Rightarrow \quad \left(\frac{\lambda}{\rho F C_p}\right) Q + T_{in} = \left(\frac{V}{F}\right)\frac{dT}{dt} + T$$

The purpose of this GUI is to allow students to investigate the impact on behaviour of changes in:

1. Tank volume (effects dynamics through time constant).
2. Flow rate of fluid (effects dynamics through time constant and gain from steam flow).
3. Flow rate of steam (input 1).
4. Input temperature of fluid (input 2).

ILLUSTRATIONS – the outlet temperature is indicated by both a graph and colouring in the picture. These change continuously as the USER changes the choices .

FILENAMES are heatexchanger.p, heatexchanger.fig . Both are needed!

Type >> heatexchanger to run

Operation of the GUI is illustrated below. Users select the desired values of tank volume, fluid flow, steam flow and inlet temperature and watch the output/tank temperature change.

1. As soon as the use changes the values in the sliders (or edit text boxes next to them), then this change is incorporated immediately and the plots will change.
2. The tank changes colour to give a pictorial view of the temperature – dark blue for cold and light purple for hot.
3. The heater changes thickness to give a view of the heat supply.