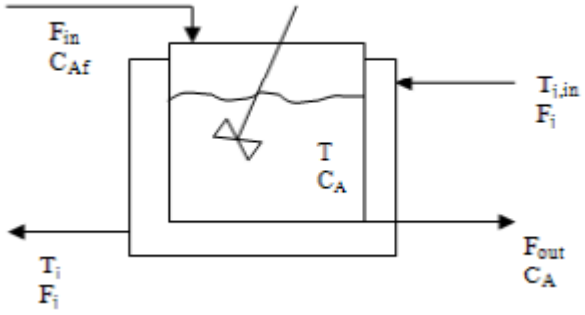
Numerical solution method

(Ordinary Differential Equations)



Energy balance for tank:

$$\frac{dT}{dt} = \frac{F}{V}(T_i - T) + \frac{UA(T_j - T)}{V\rho c_p} \qquad (1)$$

Energy balance for the jacket:

$$\frac{dT_j}{dt} = \frac{F_j}{V_j}(T_{j,i} - T_j) - \frac{UA(T_j - T)}{V_j \rho_j c_{p_j}} \qquad (2)$$

Matlab Function:

Water_heater.m file

```
function xout = watet_heater(t,x);
%
% X(1)= T = temperature in tank
% X(2)= Tj = temperature in jacket
% Fj = jacket flow rate
% F = tank flowrate
% Ti = tank inlet temp
% V = tank volume
% Vj = jacket volume
% rcp = density*heat capacity
% rcpj = density*heat capacity,jacket fluid
%
%parameter and steady state variable values are;
%
F =
Fj =
Ti =
Tji =
V =
Vj =
```

```
rcp =
rcpj =
UA =
T=x(1);
Tj=x(2);
% odes
dTdt = (F/V)*(Ti-T)+UA*(Tj-T)/(V*rcp);
dTjdt = (Fj/Vj)*(Tji-Tj)-UA*(Tj-T)/(Vj*rcpj);
xout(1)= dTdt;
xout(2) = dTjdt;
xout=xout';
```

Command window:

```
>> [t,x]=ode45 ('heater',[0 5],[124.6 154.9]);

>> plot (t,x(:,1))

>> xlabel('time');

>> ylabel('temperature');

>> grid minor;
```