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%Dehydrator air flow analysis

syms  dPtot

%Constant Variables
T1=293.25;
rho=1.225;
T_fire=923.15;
Cp=1009;
g=9.81;
R_tot=1.74;
Vis=15.89*10^-6;

D_pipe=.0254;
D_chim=.097;
L_pipe=1.2192;
L_box=.6096;
h_box=.3556;
h_chim=1.2192;
D_pout=.0079375;
num_h=3;

A1=D_pipe^2;
A2=((num_h/4)*pi*(D_pout^2));
A3=L_box^2;
A4=(pi/4)*(D_chim^2);

f_pipe=(64*Vis*L_pipe)/(D_pipe^2);
f_chan=(32*Vis*L_box)/ (4*(D_pipe^2));
f_box=(64*Vis*h_box)/(L_box^2);
f_chim=(64*Vis*h_chim)/(D_chim^2);

K_pipe=2*(1-(D_pipe^2/D_pout^2)^2);
K_chan=1;
K_box=0;
K_chim=.45;

Pipe1=((1/(4*A1))+(1/(4*A2)))*f_pipe;
Chan1=((1/(4*A2))+(1/A3))*f_chan;
BoxChim1=((1/A3)+(1/A4))*(f_box+f_chim);

Pipe2=(((1/(4*A1))+(1/(4*A2)))^2)*K_pipe;
Chan2=(((1/(4*A2))+(1/A3))^2)*K_chan;
BoxChim2=(((1/A3)+(1/A4))^2)*(K_box+K_chim);

%Solve for Pressure (dPtot)
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dPtot=((.25*(T_fire-
(((T1*(rho*g*(h_box+h_chim)))/((rho*g*(h_box+h_chim))-
dPtot)+T1)/2))/(R_tot*rho*Cp*((T1*(rho*g*(h_box+h_chim)))/((rho*
g*(h_box+h_chim))-dPtot)-
T1))*(Pipe1+Chan1+BoxChim1))+(.125*((T_fire-
(((T1*(rho*g*(h_box+h_chim)))/((rho*g*(h_box+h_chim))-
dPtot)+T1)/2))/(R_tot*rho*Cp*((T1*(rho*g*(h_box+h_chim)))/((rho*
g*(h_box+h_chim))-dPtot)-T1))^2)*(Pipe2+Chan2+BoxChim2)))*rho;
double(solve(dPtot))

%Set dPtot equal to pressure found
%Solve for Temperature of box (T3)
% dPtot= 2.7170;
% T3=(T1*(rho*g*(h_box+h_chim)))/((rho*g*(h_box+h_chim))-dPtot);

%Set T3 equal to temp found
%Solve for Volumetric Flow Rate (m^3/s)
% T3=  342.4092;
% Vdot=(T_fire-((T3+T1)/2))/(R_tot*rho*Cp*(T3-T1));
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