Heat Exchanger Design MATLAB Assignment

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1 Results

The following are the results of the MATLAB code. The data ledger is shown in Figure 1. The data ledger shows the data for the inlet temperature, mass flow rate of water from constant specific heat, mass flow rate of water from saturated liquid water interpolation.

Inlet Temperature (C)	Mass Flow Rate of Water Constant Specific Heat (kg/s)	Mass Flow Rate of Water Saturated Liquid Enthalpy (kg/s)
10	1.30654	1.30525
12	1.35159	1.35034
14	1.39986	1.39867
16	1.45171	1.45054
18	1.50755	1.50638
20	1.56785	1.56668
22	1.63317	1.63196
24	1.70418	1.70291
26	1.78164	1.78031
28	1.86648	1.86506
30	1.95981	1.95829

Figure 1: Data ledger

The graphs of the inlet temperature vs the mass flow rate of water from constant specific heat and mass flow rate of water from saturated liquid water interpolation are shown in Figure 2. The blue line represents the mass flow rate of water from constant specific heat and the red line represents the mass flow rate of water from saturated liquid water interpolation.

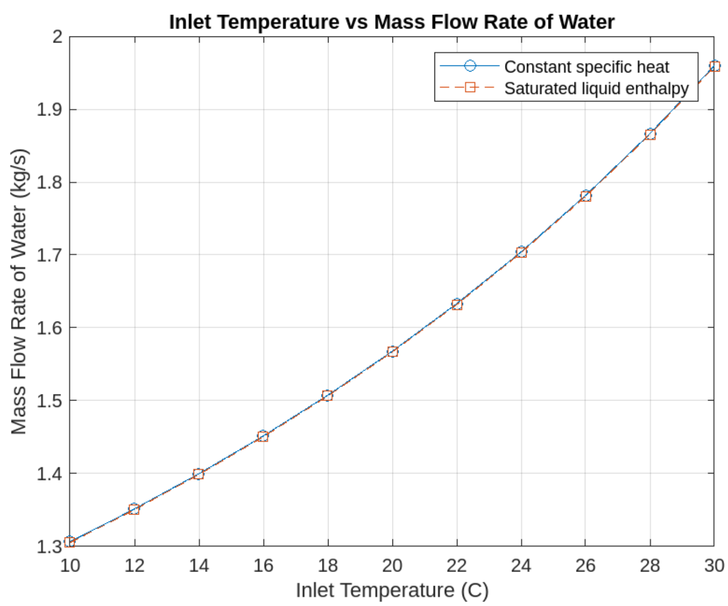

Figure 2: Graphs of the inlet temperature vs the mass flow rate of water from constant specific heat and mass flow rate of water from saturated liquid water interpolation

2 Range

This section will calculate the range of the mass flow rates of water from constant specific heat and mass flow rate of water from saturated liquid water interpolation. The range of the mass flow rates can be found using the following equation:

$$\text{Range} = \text{Maximum} - \text{Minimum} \tag{1}$$

First calculate the range of the mass flow rate of water from constant specific heat. Putting the values from the data ledger into Equation 1 gives:

$$\begin{aligned} \text{Range} &= 1.95981 - 1.30654 \\ &= 0.65327 \end{aligned} \tag{2}$$

Now calculate the range of the mass flow rate of water from saturated liquid water interpolation. Putting the values from the data ledger into Equation 1 gives:

$$\begin{aligned} \text{Range} &= 1.95829 - 1.30525 \\ &= 0.65304 \end{aligned} \tag{3}$$

Therefore, the range of the mass flow rates of water from constant specific heat and mass flow rate of water from saturated liquid water interpolation are 0.65327 and 0.65304 respectively.

3 Variance

As shown in Figure 1, the data from the mass flow rate of water from constant specific heat and the mass flow rate of water from saturated liquid water interpolation are very similar. The differences between the two data sets mostly starts at the the third decimal place. Therefore, there is not much variance between the two data sets.

4 Percent Error

To find the percent error, calculate the average of the mass flow rate of water from constant specific heat and the mass flow rate of water from saturated liquid water interpolation. The average of the mass flow rate of water from constant specific heat is found using the following equation:

$$\bar{m}_{\text{constant specific heat}} = \frac{1}{n}\sum_{i=1}^{n} m_i \tag{4}$$

Putting the values from the data ledger into Equation 4 gives:

$$\begin{aligned}\bar{m}_{\text{constant specific heat}} &= \frac{1}{11}(1.30654 + 1.35159 + 1.39986 + 1.45171 + 1.50755 \\ &\quad + 1.56785 + 1.63317 + 1.70418 + 1.78164 + 1.86648 + 1.95981) \\ &= 1.5937 \end{aligned} \tag{5}$$

The average of the mass flow rate of water from saturated liquid water interpolation is found using the following equation:

$$\bar{m}_{\text{saturated liquid water interpolation}} = \frac{1}{n}\sum_{i=1}^{n} m_i \tag{6}$$

Putting the values from the data ledger into Equation 6 gives:

$$\begin{aligned}\bar{m}_{\text{constant specific heat}} &= \frac{1}{11}(1.30525 + 1.35034 + 1.39867 + 1.45054 + 1.50638 \\ &\quad + 1.56668 + 1.63196 + 1.70291 + 1.78031 + 1.86506 + 1.95829) \\ &= 1.5924 \end{aligned} \tag{7}$$

Now that the averages are found, the percent error can be calculated using the following equation:

$$\text{Percent Error} = \left| \frac{\text{Experimental Value} - \text{Theoretical Value}}{\text{Theoretical Value}} \right| \times 100\% \tag{8}$$

Assuming that the mass flow rate of water from saturated liquid water interpolation is the theoretical value and the mass flow rate of water from constant specific heat is the experimental value.

Putting the values from Equations 5 and 7 into Equation 8 gives:

$$\begin{aligned}\text{Percent Error} &= \left| \frac{1.5937 - 1.5924}{1.5924} \right| \times 100\% \\ &= 0.000816 \times 100\% \\ &= 0.0816\% \end{aligned} \tag{9}$$

Therefore, the percent error of the mass flow rates of water is 0.0816%.

5 Sources of Error

The sources of error are the assumptions made in the MATLAB code. The first assumption is that the specific heat of water is constant. This is not true because the specific heat of water changes with temperature. The second assumption is that the mass flow rate of water from saturated liquid water interpolation is accurate. The interpolation can be inaccurate because the interpolation is approximating the data using lines which may or may not accurately represent the data.

6 Conclusion

This report concludes with the following:

1. The range of the mass flow rates of water from constant specific heat and mass flow rate of water from saturated liquid water interpolation are 0.65327 and 0.65304 respectively.

2. The variance between the mass flow rate of water from constant specific heat and the mass flow rate of water from saturated liquid water interpolation is very small.

3. The percentage error of the mass flow rates of water is 0.0816%.

4. The sources of error are the assumptions made in the MATLAB code. The first assumption is that the specific heat of water is constant. This is not true because the specific heat of water changes with temperature. The second assumption is that the mass flow rate of water from saturated liquid water interpolation is accurate. The interpolation can be inaccurate because the interpolation is approximating the data using lines which may or may not accurately represent the data.