EXPERIMENT #5

To: All Groups
Subject: Double Pipe (Concentric) Heat Exchanger
Prepared by: S. V. Ekkad

Experimental Objectives

The process of heat exchange between two fluids that are at different temperatures and separated by a solid wall is achieved by a device termed as Heat Exchanger. Heat exchangers are typically classified according to flow arrangement and type of construction. The simplest heat exchanger is one where the hot and cold fluids move in the same or opposite directions in a concentric tube (or double pipe) construction. In the parallel-flow arrangement, the hot and cold fluids enter at the same end, flow in the same direction, and leave at the same end. In the counter-flow arrangement, the fluids enter at opposite ends, flow in opposite directions, and leave at opposite ends (see Figure 1).

In this experiment, you are expected to determine the heat exchange performance of parallel flow and counter flow concentric pipe heat exchangers and to compare their performance.

You will use the commercial pipe heat exchanger apparatus available in the laboratory. Flow rates and water temperatures of both hot and cold water can be measured at various points along the flow circuit. The apparatus can be operated in the parallel-flow or counter-flow modes.

Present the temperature distribution of the heat exchanger pipe from inlet to exit for both cold and hot flows with both flow arrangements. Also calculate the overall coefficient of heat transfer, $U$, and the effectiveness, $\varepsilon$, at different flow rates for both flow arrangements.

Keywords
Heat Exchanger
Parallel-Flow
Counter-Flow
Effectiveness
NTU

Available Equipment
Heat Exchanger Apparatus
Thermocouple Readouts

Reading Assignment
Read Chapter 11, sections 11.1, 11.2, 11.3, and 11.4 from reference [1].
**Procedure**

1. Calibrate the flow meters using a stop watch and a known volume collector bucket.
2. Set valves for parallel flow heat exchanger arrangement. Set the hot water flow rate to its maximum. Adjust to the required cold flow rates and make temperature measurements for different constant flow rates.
3. Set the cold water flow rate and wait for 8-10 minutes for the system to reach thermal equilibrium.
4. Record temperatures at thermal equilibrium state.
5. Repeat steps 2-4 for three other cold water flow rates.
6. Repeat steps 2-5 for the counter flow heat exchanger arrangement.

Figures 1 & 2 show the temperature distribution along the heat exchangers from inlet to exit for both hot water and cold water for both parallel and counter arrangements.

[Fig. 1 Parallel Flow Heat Exchanger](#)

[Fig. 2 Counter Flow Heat Exchanger](#)
Results

1. provide plot of temperature vs. heat transfer area
2. calculate (ΔT)_{mean} for the total heat exchanger
3. Calculate total heat transferred for each configuration and flowrate
4. Calculate and plot overall U values for each heat exchanger configuration
5. Plot effectiveness versus NTU_{min}

Discussions

1. Discuss the possible best results you can obtain for each exchanger configuration. Why are you not getting the outlet water temperatures to be equal?
2. Discuss your results and explain them with physical understanding of the heat transfer phenomena. Discuss also discrepancies in your results.

References