Chapter V

EXPERIMENTAL CONSIDERATION

5.1 Calibration of Flow Meters

Two flow meters, orifice type, were calibrated. The meters were used to indicate the flow rates of hot water and cold water. When water flows through an orifice meter, a pressure drop developes for a particular flow rate. This pressure drop is generally indicated by a mercury manometer. Calibration of each of the orifice meters was carried out by varying the rate of water flowing through the meter. Each flow rate was calculated by recording the time required to collect a certain amount of water flowing through the meter. The corresponding pressure drop for each flow rate was also measured from the attached manometer, and it was recorded. The calibration of each meter was plotted as flow rate in kg/min versus manometer reading in cm.Hg, as shown in Figures 5.1 and 5.2

5.2 Calibration of Thermocouple

In this work two thermocouples were used to measure the wall temperatures of inner tube of the double pipe heat exchanger. The thermocouples were calibrated with a potentiometric recorder by varying the temperature of the water in

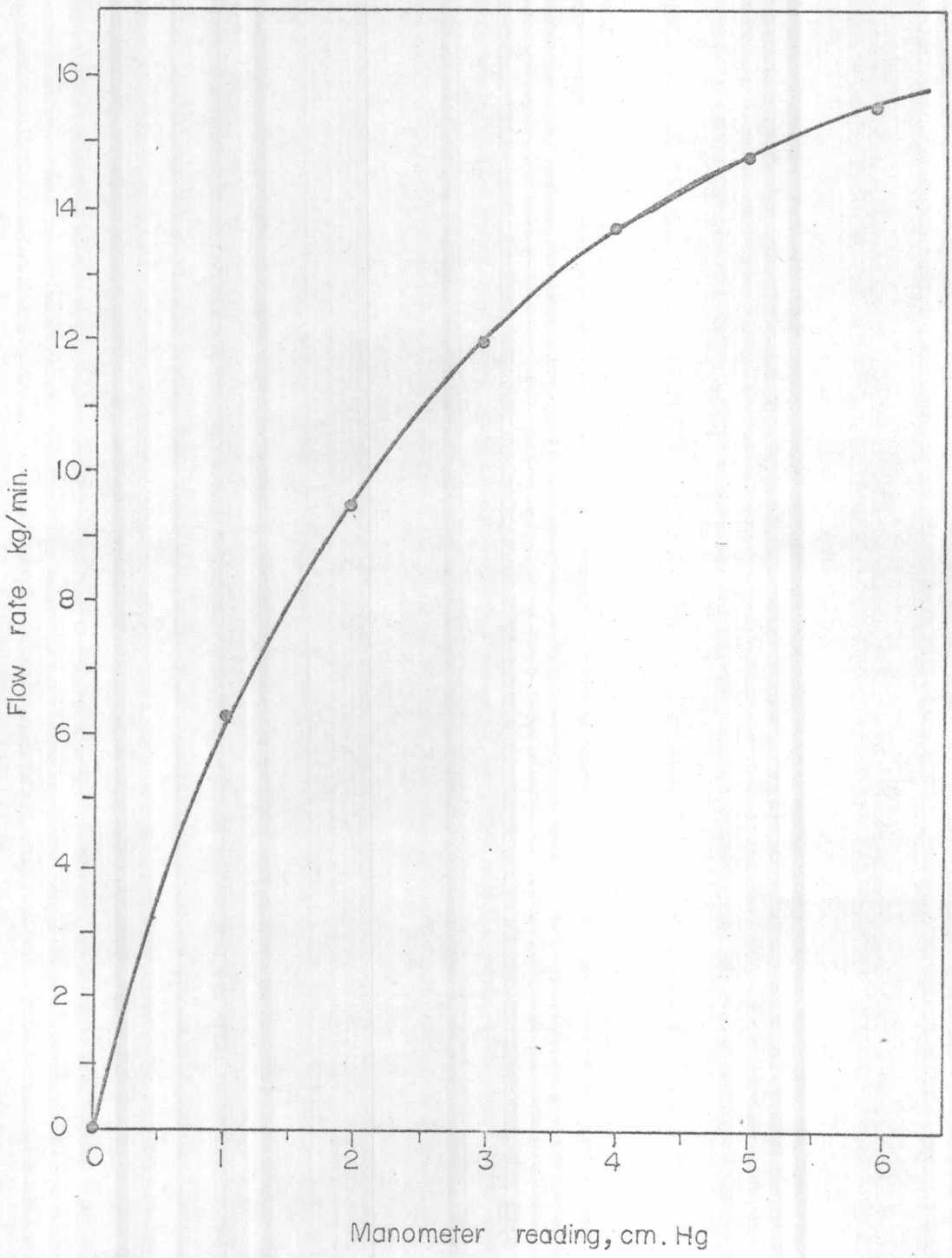

Fig. 5.1 Calibation of Hot water orifice meter .

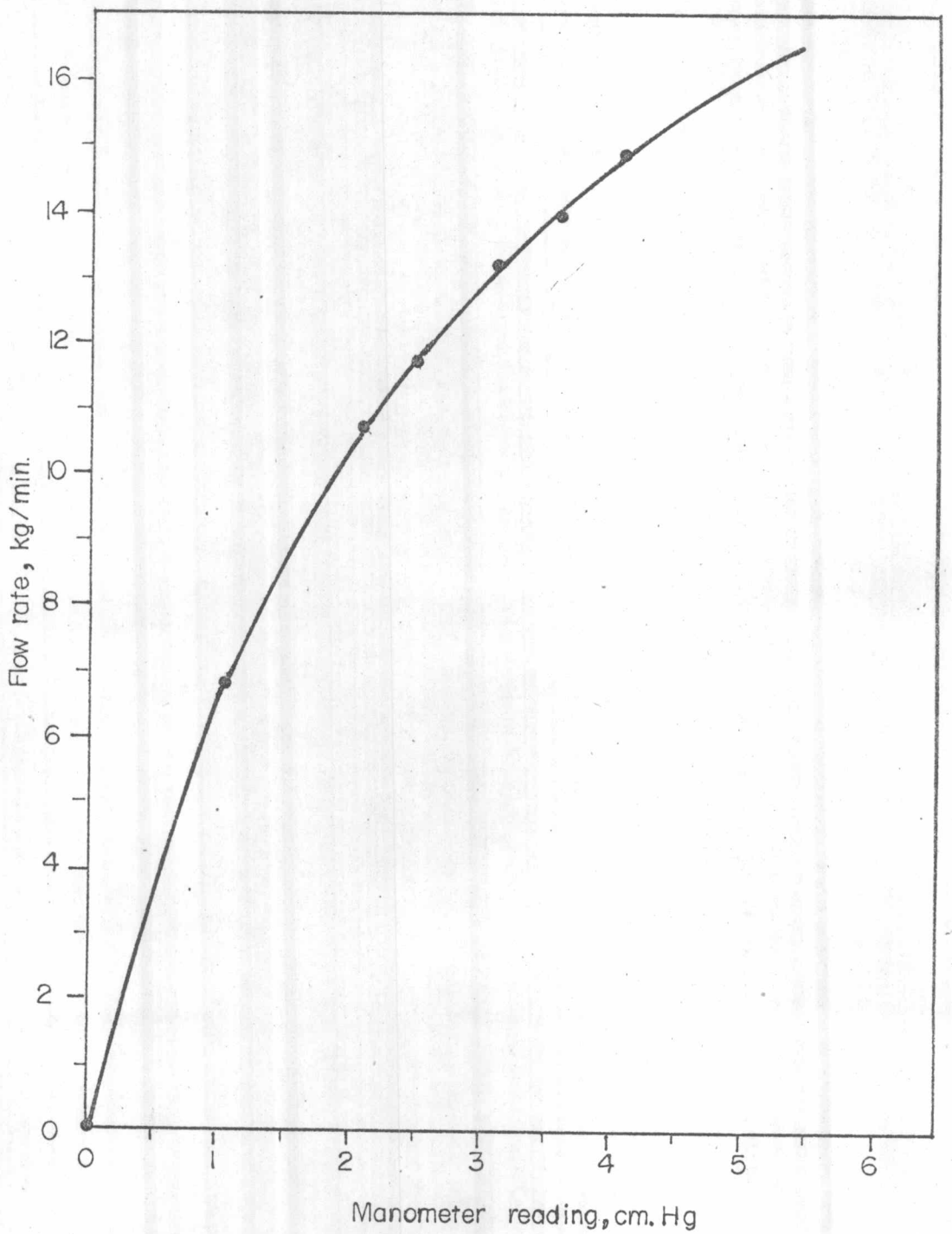

Fig. 5.2 Calibration of Cold water orifice meter.

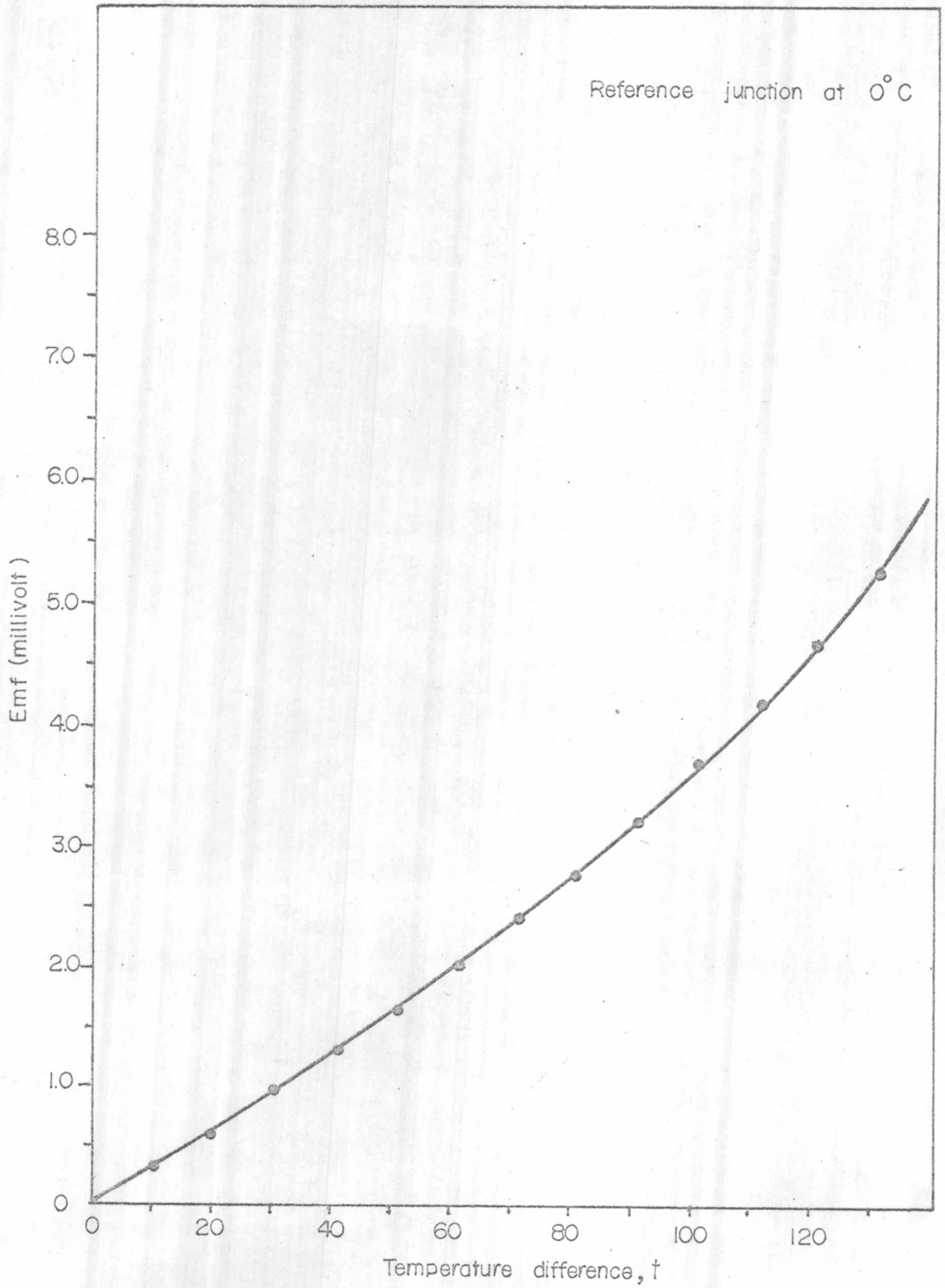

Fig. 5.3 Calibration curve of Cu - Constantan thermocouple.

which the thermocouple were immersed. The millivolts that read from the recorder at various temperatures were plotted versus the temperature differences in degree celcius. The reference temperature was kept at room temperature. The calibration curve is shown in Figure 5.3

5.3 Experimental Variables and Experimental Runs

The process variables which were studied are:-

5.3.1 The flow rates of cold water and hot water

Four hot water flow rates were used, and they are 15.5, 14.8, 13.7 and 11.8 kg/min., which are corresponding to the manometer readings of 6.0, 5.0 4.0 and 3.0 cm.Hg

Six cold water rates were used, and they are 14.8, 13.8, 13.1, 11.6, 10.5 and 7.2 kg/min, which are corresponding to the manometer readings of 4.0, 3.5, 3.0, 2.5, 2.0 and 1.0 cm.Hg

5.3.2 The inlet temperature of hot water

Two mean temperatures of hot water inlet were used, they are 72 and 82°C.

5.3.3 Inorder to find the effects of cycle time and fraction open on the over all heat transfer coefficient, several experimental runs were performed for various combinations of the two variables. Each run was carried out using the procedure deseribed in the next section.

For calculating the over all heat transfer coefficient twenty-four runs were carried out at two inlet hot water temperatures and various combinations of cycle time and fraction open. Each experimental run was repeated three times. For conventional operation the fraction open was taken as unity.

a. Inlet temperature of hot water 72°C

i) cycle time 6.1 seconds
fraction open 0.5, 0.6, 0.7, 1.0

ii) cycle time 10 seconds
fraction open 0.5, 0.6, 0.7, 1.0

iii) cycle time 13 seconds
fraction open 0.5, 0.6, 0.7, 1.0

b. Inlet temperature of hot water 82°C

i) cycle time 6.1 seconds
fraction open 0.5, 0.6, 0.7, 1.0

ii) cycle time 10 seconds
fraction open 0.5, 0.6, 0.7, 1.0

iii) cycle time 13 seconds
fraction open 0.5, 0.6, 0.7, 1.0

5.4 Experimental Procedure

The procedure used in the present experiments consisted of several steps:

1. The boiler was started up. It took about half an hour to generate surfficient steam used in the experiment.

2. While waiting for saturated steam, the experimental equipment while was shown schematically in Figure 4.1 was set ready for the experiment. All valves were open to allow hot water from the heater and cold water from the supply line to flow through and fill up the entire system. Hot water was flowing in the annulus, while cold water was flowing in the inner pipe.

In this work, the flows were countercurrent.

3. The inlet steam valve of hot water heater was adjusted to the required temperature; 72°C or 82°C.

4. The flow rates of the two fluids were adjusted and controlled by using the orifice-meters, and their values were recorded.

5. After 20 minutes, the system was in steady-state condition, temperatures at various points were recorded.