CHAPTER 5

CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

5.1 Conclusions

The helical coils of micro-diameter tubes have attractive features for heat exchanger manufacturers due to their compactness and heat transfer enhancement capabilities. Understanding of the heat transfer mechanism through helical coil of micro-diameter tubes is very important for designing efficient heat transfer system. In view of this the present study has focussed on the study of fluid flow in helical coils of micro-diameter tubes as well as heat transfer. Effort has been made to develop dimensionless generalized correlations for friction factor and Nusselt number for helical coil based heat transfer system. The conclusions derived from the present study are summarized below:

- The experimental data for pressure drop in straight and helical coil satisfy the general relation $\Delta P \alpha u^2$ for laminar flow.
- As expected the pressure drop in case of water is higher compared to those for methanol and acetone due to its viscous nature. Methanol gives higher pressure drop than acetone.
- Tube diameter has significant effect on pressure drop. As the tube diameter decreases pressure drop increases.
- The pressure drop in helical coil sections is comparatively higher than that for the straight micro-diameter tubes of the same diameter and length.
- For straight tube sections the friction factor results show excellent agreement with the laminar flow equation for smooth straight tubes.

- The difference between friction factors for the helical coil and the straight tube is small at low Re compared to that at high Re

- A generalized correlation in terms of (f_c / f_s) and De number with standard deviation of $\pm 8\%$ is proposed for laminar fluid flow study in helical coil valid for $\delta = 0.012 - 0.017$ and $45 < De < 270$.

$$\frac{f_c}{f_s} = 1 + 0.008 \quad De^{\,0.897}$$

- An increasing trend in the average heat transfer coefficient is observed with increasing flow velocity. This trend is similar to that reported by previous workers.

- Heat transfer coefficient in water is much greater than that for methanol and acetone due to its better thermal properties.

- An exponential decrease in average wall temperature and bulk fluid temperature has been noticed.

- Nusselt number increases linearly with Reynolds number on log-log plot.

- A generalized correlation which is valid for $\delta = 0.012$ -0.1, $De = 49 - 632$ and $\Pr = 3.5 - 7.38$

  $Nu = 0.002\, De^{1.2621}\, \Pr^{0.89}$

  with a standard deviation of $\pm 18\%$ is proposed for laminar flow heat transfer study

5.2 Suggestions for future work

- In view of the increasing application of helical coil of micro-diameter tubes in compact heat exchanger experiments using different fluids (particularly nanofluids) flowing through helical coil experiment should be performed.

- It would also be interesting to investigate the flow and heat transfer behaviour during two phase flow.

- It would be interesting to generate data for flow and heat transfer in helical coil of micro-diameter tube with range of different coil diameter and coil pitch.
- Study of flow and heat transfer behaviour of such systems using CFD and other computational techniques will be helpful in evaluating the physics of transfer processes.