PREFACE

Heat dissipation is a major problem for researchers and engineers. Heat exchangers with helical coil play very significant role where very high heat transfer performance is desired. Helical coil heat exchangers are vastly used in process industries as they provide high heat transfer coefficients because of their small hydraulic diameters. Extensive experimental and numerical work using conventional and mini size helical coils and heat exchanger have been reported by different researchers in laminar and turbulent flow regimes. However, information regarding helical coil and heat exchangers having small diameter tubes are limited. This was the main reason for choosing the subject for this thesis.

The present research has focused on the fluid flow and heat transfer in helical coils of micro-diameter tubes under laminar flow conditions. Effort has been made to develop a generalized correlation for helical coils. The experiments have been conducted for single phase laminar flow inside helical coils of micro-diameter tubes. Experimental results have shown that tube diameter has significant effect on pressure drop. The pressure drop in helical coil sections has been found to be comparatively higher than for the straight micro-diameter tubes of the same diameter and length. The experiments are also conducted for laminar flow heat transfer inside a helical coil of micro-diameter tube under constant heat flux conditions using the same working fluids as used for fluid flow studies. The results have shown that trend of average heat transfer coefficient is similar to that reported by previous workers.

The thesis has been arranged in five different chapters; Chapter one incorporates introduction, practical applications and importance of the helical coils based heat exchangers.

Chapter two presents a detailed literature survey on experimental study, numerical study, both experimental and numerical studies in helical coils and heat exchangers.

Chapter three describes the details of experimental setup, its components, technical details of helical coils and experimental procedure. This chapter also deals with standardization of experimental setup and standard equations used for the calculation of friction factor and heat transfer.

Chapter four is devoted to results and discussions focussing on various issues such as validation of experimental setup, variation of friction factor and Nusselt number with Reynolds and Dean numbers for helical coils. The comparison of the experimental results for flow and heat transfer in helical coils with values predicted from available correlations in published literature are also discussed in this chapter. In the same chapter on the basis of present and previously reported data, generalized correlations have been developed for friction factor and heat transfer coefficient for laminar flow in helical coil

In the last chapter five, conclusions derived from the present study and suggestions for future work are listed.

Appendix A deals with sample calculations for friction factor and Nusselt number in helical coils. In appendix B generalized correlations are developed in terms of friction factor and Nusselt number for helical coils. These correlations are developed by least squares regression analysis. Appendix C includes detailed information about uncertainty analysis in flow and heat transfer in helical coils of micro-diameter tubes. All the associated tables are given in Appendix D.