

THERMAL MODELLING OF SOME SOLAR WATER HEATERS

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NEW DELHI, INDIA
1983**

DEDICATED

TO MY WIFE AND DAUGHTER

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and

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ACKNOWLEDGEMENTS

I find no words to express my deep sense of gratitude to Prof. H.P. Garg and Dr. G.N. Tiwari for their generosity, valuable suggestions, kind encouragement and constant inspiration throughout this work, without which the present ^{work} would not have been possible.

I am thankful to Prof. M.S. Sodha, Deputy Director, IIT, New Delhi, and Prof. B.B. Tripathi, Head of the Department, Physics Department, IIT, Delhi, for their encouragement and interest in the work.

I am thankful to Prof. S.S. Mathur, Head, Centre of Energy Studies, Prof. B.C. Roychowdhury, Prof. S.P. Sabberwal, Drs. N.K. Bansal, N.D. Kaushik, S.C. Kaushik, P.K. Bansal and A. Kumar for their deep interest and encouragements.

I am much indebted to Dr. (Miss) Usha Singh, Mr. V. Bapeshwara Rao, Mr. S.K. Rao, Mr. S.N. Garg and Dr. V.K. Sharma for their friendly cooperation and helpful discussions.

ABSTRACT

This dissertation deals with the analysis of flat plate solar collector both of conventional type and of other types. Convection is a predominant phenomenon taking place in all sorts of flat plate collectors. So in the beginning study of convection has been made for parallel flat plate collector at various tilt angle also including vertical (90°) one. Some studies of spacing between two adjacent tubes for bonded tube collectors and serpentine tube collectors have been made. Here studies with the performance of steady-state flat plate collectors have been made. Next, analysis of unsteady state parallel flat plate collectors have been made for states without evaporation, with evaporation and inverted solar collector. For the same climatological conditions the inverted solar collector has better performance compared to the other two. In this, studies have been made to see the effects of various parameters, viz. the depth of water flow between the absorber and the glass plate, velocity of water flow, length of the collectors etc. Solar intensity and ambient temperature variations during the day have been considered periodic and Fourier analysis have been made for these, by incorporating the data for a typical day in Delhi. Calculation of water temperature T_w °C and heat gained Q (Watts) for various cases have been done and predictions can be made about them from the meteorological data like solar intensity on the surface and ambient temperature.

Also forced circulation water heating system has been studied including a heat exchanger for parallel plate flat plate collector (having no bonded tubes). Effect of various collector parameters and the system on its performance have been studied.

Lastly performance of collection/storage water heater has been considered and studied. In it built-in-storage water heater and shallow solar pond have been considered. It incorporates the effect of duration of the covering system by insulation during night and low solar intensity period and mass flow rate through the system. In it all the parameters like solar intensity, ambient temperature, heat transfer coefficients and the flow rate are Fourier analysed and an analytical expression for water temperature and heat retrieval from the system have been obtained.

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