THERMAL MODELLING OF SOME SOLAR WATER HEATERS

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DEDICATED

TO MY WIFE AND DAUGHTER

Mrs. Minakshi Husain

and

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ABSTRACT

This disseration 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^{o}) 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 ofthe 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 ^{o}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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