ANALYSIS AND OPTIMIZATION OF SOLAR COLLECTORS FOR HEATING OF FLUIDS

by

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TO MY GRANDFATHER

to

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ABSTRACT

The present thesis focuses on various design aspects of flat-plate solar collectors, which do affect the performance of the system to a great extent. On the basis of theoretical computer models, few design parameters are optimized which are justified experimentally afterward in some cases.

Various heat losses from flat-plate collector are studied and mathematical relations are derived for selecting the optimum gap according to the temperature requirement. A criteria for using the heavy gases in the enclosed space between glass cover and absorber plate is proposed. The effect of internal spacing of glass covers is studied and a new two glass cover system is proposed in which the upper enclosed space is evacuated. This study may be useful in tubular collectors.

An indoor calorimetric test set-up is made to study the conductance of the pipe/fin junction in flat-plate collectors and various type of bonds are tested experimentally.

The effect of various design parameters and different duct shapes is studied thoroughly and on the basis of computed results a most cost-effective system is evolved.

A transient study of the compact built-in-storage water heater is carried out and effect of glazing, depth of storage tank, insulation cover and baffle plate is studied. In all the cases the optimum depth of the storage tank is found out. Theoretical results are also tested experimentally.

A new and simple polynomial is suggested for the theoretical computation of instantaneous solar radiation.

A transient study of the flat-plate air heater is done and the effect of thermal capacity of various collector nodes, effect of heat transfer coefficients and flow rate etc. is studied. Three different type of air heaters are tested experimentally and their thermal performances are compared.

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