DESIGN ANALYSIS AND STUDIES ON SOME SOLAR AIR HEATERS

BY

VINOD KUMAR SHARMA

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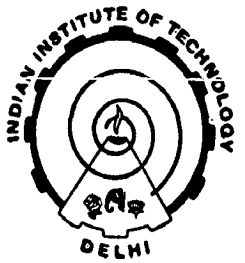

CENTRE FOR ENERGY STUDIES
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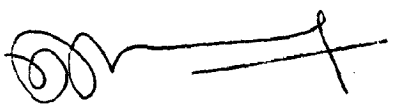
TO MY PARENTS

CERTIFICATE

It is certified that the thesis entitled, "Design analysis and studies on some solar air heaters" has been completed by Mr. V. K. Sharma under my supervision. It is original in nature and I have permitted the candidate to submit it for the degree of Doctor of Philosophy in Solar Energy.



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Sharma 28/7/87

(VINOD KUMAR SHARMA)

SUMMARY

This dissertation deals with the analytical and experimental analysis of flat-flate solar air heaters both of conventional and of novel type. The main objective of this thesis is to study the effect of various climatic, design, and operating parameters on the performance of fixed configuration type of few conventional and novel type of solar air heaters in conventional and unconventional modes of operation.

The transient analysis of solar air heater has been attempted in order to determine the dependence of the transient behaviour on various design parameters. Thorough analysis of heat balance equations of different components of a solar air heater along with experimental validation in some cases, is reported. With the help of computer models, the author has seen the effect of flow rate, plate length, selective coating, thermal capacitance, metallic plate thickness etc. in a single attempt. The periodic responses have also been studied for different combinations of parameters. Moreover, an air heater in nonconventional mode of operation has also been studied. This is achieved by making air flow rate time dependent.

Detailed theoretical analysis of three different configurations of double exposure solar air heaters has been attempted vigorously. A self consistent periodic analysis of multiple pass solar air heater has been developed the very first time. So far no meaningful theoretical comparison of this novel type of solar air heater is done with other possible mode of conventional solar air heaters. The author has developed the theory of a multiple pass solar air heater where air makes four passes before exit. In this study a single plate air heater with maximum of four glass cover plates is considered. The performance of the system with 1,2 and 3 passes was also conducted. The effect of number of glass cover plates on the 1, 2, 3 passes has also been investigated. It is noted that multiple pass solar air heater proposed in this thesis performs much better for low flow rates and large plate length. For small plate length and high flow rates addition of cover plates does not effect the performance of 2 or 3 passes air heater. Moreover, study of a two pass solar air heater is also reported. The aim of this study was to analyse in as much detail as possible, theoretically, two pass solar air heater and to compare its performance with possible configurations of conventional solar air heater.

The performance results of two matrix air heater with single and double glazing, using waste iron scraps from the lathe machine, are also presented. These results are compared with those of a conventional type air heater. Moreover, experimental investigation on a prototype rock-bed solar collector, attempted the first time are also included. Apart from presenting in brief the basic idea of rock-storage system, it also deals with experimental observations of thermal decay of rock storage medium, its preliminary economic analysis and an overall discussion about its applicability.

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