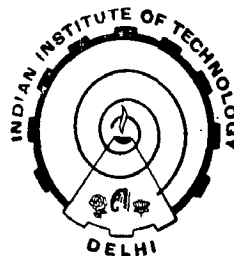


OPTICAL AND THERMAL MODELLING OF TUBULAR SOLAR COLLECTOR

by
SUMANA CHAKRAVERTY

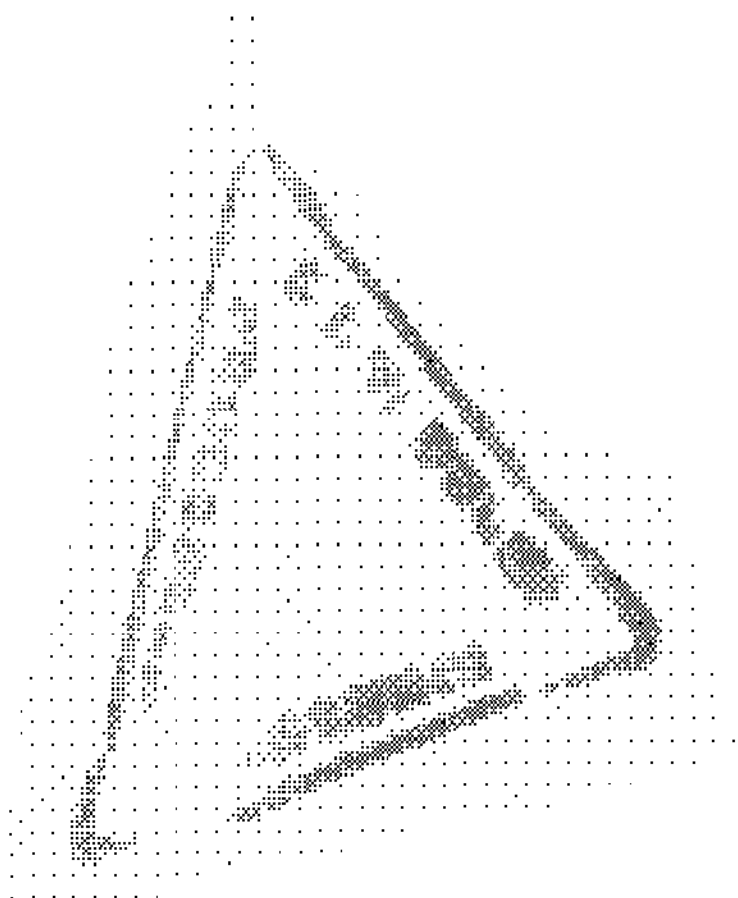
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Dedicated to

'MASHIMA'

Late Smt. Aruna Roy

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(SUMANA CHAKRAVERTY)

ABSTRACT

As the title suggests, this thesis deals with the, in-depth analysis of evacuated tubular collectors, which can outperform the flat plate collectors and under certain situation the linear concentrators also. The analysis is restricted to the thermal and optical modelling of the evacuated tube, with the hope to improve its performance under the given conditions.

Optical analysis of a flat plate collector with tubular cover arrangement has been carried out extensively. It is observed by exhaustive analysis that, this arrangement performs better than the conventional double glazed collectors. It is also found that, the hour angle in this case should be considered for optical analysis, instead of angle of incidence, as is the general practice. A generalised theory for the computation of optical efficiency of finned absorber tubular collector has been developed and used to compute the optical efficiency for various collector tilts, orientation and for various times of the year. The optical analysis of a conventional coaxial evacuated tubular collector has also been carried out for various tilts and orientations and performance has been compared with the earlier two systems.

Extensive theoretical analysis for predicting the thermal performance of coaxial tubular collector under transient condition, both in case of steady source and time dependent source. The effect of various parameters, like, evacuation, selective coating, flow rate etc. on the thermal performance have been studied in the above model and compared with experimental results under certain situations. Studies have also been conducted on the thermal performance of the evacuated tubes, when they are connected in different modes of connection, viz, series, parallel, $2\Delta T$ steps, $3\Delta T$ steps and $4\Delta T$ steps. Series connection, upto twelve tubes is found to be better compared to all other modes. A theoretical model for performance prediction of a finned absorber, double walled tubular collector has also been carried out. The effect of various parameters like, outer glazing, selective coating, evacuation, fluid flow rates etc. with a constant radiation source have been studied.

Thus, in this thesis, a few new concepts in the optical and thermal modelling of evacuated tubular collectors of three different configurations have been developed and studied in depth.

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