SELECTIVE COATINGS AND HEAT LOSS MINIMIZATION IN FLAT PLATE COLLECTORS OPERATING UNDER CONCENTRATED SOLAR FLUX

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Thesis submitted to the
Indian Institute of Technology, Delhi
for the award of the degree of
DOCTOR OF PHILOSOPHY

Centre of Energy Studies

INDIAN INSTITUTE OF TECHNOLOGY, DELHI

1983

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10/9/85

ACKNOWLEDGEMENTS

It is with immense pleasure I express my deep sense of gratitude to Dr.H.K.Sehgal, Assistant Professor, Department of Physics, Indian Institute of Technology, Delhi, for his supervision and guidance during the course of this work. His inspiration and encouragement were of great help to complete the present investigations. I also express my gratitude to Dr.R.C.Tyagi for his encouragement and valuable suggestions during the initial stages of the work.

I am sincerely grateful to Prof. S.S.Mathur, Centre of Energy Studies, I.I.T.Delhi, for his consistent encouragement and for providing the facilities related to the fabrication of the concentrator and collector assemblies. I would also like to express my gratitude to Prof.K.L.Chopra, and Prof. O.P.Agnihotri, Department of Physics, for providing some measurement facilities in their laboratories. I am extremely thankful to Dr.G.N.Tiwari, Assistant Professor, Centre of Energy Studies, I.I.T.Delhi, for his invaluable help in theoretical investigations in Chapter - IV. Thanks are also due to Dr.R.Thangaraj and Dr.A.Raza, Department of Physics for their help in spectral reflectance and total absorptance measurements.

I extend my sincere thanks to my colleagues, Miss C.Choudhury, Mr. Mukesh Jain and Mr. Subodh Kumar, who helped me on various occasions during the course of this work. Thanks are also due to my friends, Mr. Hrishikesan,

Mr. Subbi Reddy and Dr. Rama Murthy for their help at different stages of the work. Thanks are also due to many other friends and well wishers for their help and moral support during the course of investigations.

I would also like to acknowledge the Indian Institute of Technology, Delhi for providing financial assistance during this work.

I offer my sincere thanks to Mr. C.M.Manocha for his neat and efficient typing and to Mr.N.S.Gupta for the excellent figures he has made with great patience.

(M.Madhusudan)

ABSTRACT

The work reported in this thesis is devoted to the investigations on various components of a solar thermal system capable of providing work fluid temperatures in the range 100-200°C. The experimental measurements and/or theoretical analyses, as carried out by the author, aim at the specific purpose to work out inexpensive but effective materials and growth processes for selective absorber coatings and to work out the geometrical design parameters and operational configuration of the collector to achieve minimum heat losses from the absorber collector assembly. The investigations also aim at working out a concentrator design and configuration which could effectively concentrate the solar flux on the absorber while requiring minimal tracking. The investigations are further extended to study the performance of a solar thermal system which incorporates the optimized designs and operational configurations of the absorber collector and the concentrator. The experimental and the theoretical investigations carried out by the author in this direction are presented in seven chapters in the thesis.

Chapter I considers the basic requirements of a medium temperature (100-200°C) solar thermal system for efficient operation and includes a brief review of the available literature related to the materials, components and subsystems of such solar thermal systems.

Chapter II includes the experimental set ups used by the author for the growth of selective absorber coatings and for the

measurements of photothermal, thermal, structural and optical characteristics of the films. Experimental set ups used for comparative solar thermal performance of the flat plate collectors to work out the optimized collector geometry and operational configurations are also included.

Chapter III is devoted to the study of growth of solar selective coatings of black nickel, NiS-PbS and NiS-CdS mixed films. Chapter IV is devoted to the experimental and theoretical investigations to optimize the collector geometry and operational configurations for stagnant and fluid flow conditions. Chapter V is devoted to the performance analysis of a Fresnel reflecting concentrator for its various possible settings and operational configurations. Performance in field conditions of a test system incorporating the optimized collectors of chapter IV and the experimental concentrator of Chapter V is reported in Chapter VI. Some possible directions in which the work done by the author could be extended are proposed in Chapter VII.

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