SOLAR PONDS AND OTHER COLLECTOR/STORAGE SYSTEMS

by

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

DEPARTMENT OF PHYSICS

Indian Institute of Technology, Delhi

March, 1981

TO MY PARENTS

ACKNOWLEDGEMENTS

It is my great pleasure and privilege to express profound indebtedness to Professor M.S.Sodha for his invaluable supervision, perennial source of help, everlasting inspiration and stimulating discussions as a consequence of which the present study reached fruition.

I wish to express my deep sense of gratitude to Dr. N.D.Kaushik for his unstinting guidance and unfailing help in suggesting the problems at all stages of this work and making a detective perusal of the whole manuscript. My sincere thanks are also due to Dr S.C.Kaushik for his kind inspiration, supervision and constant encouragement during the tenure of the present research work.

Grateful thanks are due to Prof. S.S.Mathur, Prof. H.P.Garg, Prof. S.P.Sabberwal, Dr. N.K.Bansal and Dr.G.N.Tiwari for their active interest and support.

Varily and virtually, I feel obliged towards Drs. Qayam, Bhumesh, Govind, Jayanta, Alok and Kandpal for their excellent understanding and hospitable attitude. My special thanks are also due to my colleagues Ms.Usha Singh, Ms. Naresh Dhiman, Messers N.J.S. Maken, P.K.Gupta, H.C.Dak and other members of Solar Energy Lab(II) who occasionally lent their concern with the progress of my work.

It gives me great pleasure to appreciate the cooperation extended by the facility staff at Centre of Energy Studies for their intelligent and skillful drafting and typographical assistance. In particular, I am thankful to Shri T.N.Gupta and Mr. Kripal Singh.

Last but not the least, I have no befitting words to express my deep sentiments towards my colleagues, ASHVINI, SUBHASH and RAO for their unlimited cooperation, everhelpful attitude and timely encouragement.

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SUMMARY

This thesis presents the investigations of the thermal processes in salt gradient solar ponds, water heaters and other collector/storage systems. A self consistent periodic analysis of a partitioned solar pond collector/storage system has been developed to predict the behaviour of the pond as a passive heat source for various applications. Two modes of heat extraction are considered viz.

(i) Heat extraction by constant flow of heat removal fluid.
(ii) Heat extraction at constant temperature.

The analysis has enabled the optimization of the pond parameters. The optimum heat retrieval efficiencies of 27.5%, 34% and 40% corresponding to heat retrieval temperatures of 97°C, 60.5°C and 45.5°C respectively are predicted for the water flow rates of 2×10^{-4}, 5×10^{-4} and 10^{-3} kg/s.m^2 respectively. A theoretical analysis of salt gradient stabilized solar pond as a steady state solar energy flat plate collector has been carried out; the expressions for efficiency are seen to be similar to those obtained by Hottel-Whillier and Bliss for flat plate collectors. The growth of temperature profile, heat and mass transfer at the surface and the stability of the gradient in a salt gradient solar pond of shallow depth have been investigated analytically as well as experimentally.

The models characteristic of the thermal performance of built in storage solar water heater and the shallow solar pond water heater have been developed for arbitrary demand patterns of hot water for industrial as well as domestic applications. Analytical investigations of single and double exposure solar air heaters have also been made taking into account the conduction of heat along the length of the absorption plate in the direction of air flow. Eventually, a novel concept of cooling a roof by flow of water over it has been examined by explicitly taking into account the heat and mass transfer processes at the air-water interface.

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