THERMAL PERFORMANCE OF REGENERATORS AND WASTE HEAT RECOVERY

by

A. I. KHANDWAWALA

A Thesis

submitted in fulfilment of the requirements of the

degree of

DOCTOR OF PHILOSOPHY

to the

Indian Institute of Technology, Delhi

January, 1980

CERTIFICATE

This is to certify that the thesis entitled "THERMAL PERFORMANCE OF REGENERATORS AND WASTE HEAT RECOVERY" has been prepared under my supervision in conformity with the rules and regulations of the Indian Institute of Technology, Delhi. I further certify that the thesis has attained a standard required for a Ph.D. degree of the Institute. The results contained in this thesis have not been submitted in part or full to any other University or institution for the award of any degree or diploma.

O.P. Chawla

Dr. O. P. Chawla

Chief Design Engineer
IDDMEC
Indian Institute of Technology
New Delhi-110029

ACKNOWLEDGEMENT

It is with great pleasure that the author records his deep sense of gratitude to Dr. O.P. Chawla who suggested the research problem and supervised the work reported in this thesis. Dr. Chawla's unceasing enthusiasm, fruitful discussion and constant encouragement inspired the author at all stages for this work.

Thanks are to the staff of Mechanical Engineering Workshops and Heat Transfer Laboratory, in particular to Mr. Shyam Lal, Mr. Dua and Mr. Kirti Singh for their help in erecting the experimental set up and in conducting the trials. Thanks are also due to the staff of Steam Lab. for running the boiler for the experimentation.

The staff of the Computer Centre of the I.I.T. deserve special thanks for their help and cooperation in punching the cards and running the programme.

The support rendered by the Ministry of Education, Government of India for the financial help under the Q.I.P. Scheme is gratefully acknowledged.

The author also thanks all his friends, Anis, Shailendra and Tapan in particular, who have helped in one way or the other.

Finally, the thanks are due to Mr. B.L. Tuli who typed the manuscript and Mr. P.R. Gauba, who prepared the figures.

A. I. Khandwawala

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ABSTRACT

The effects of steam addition to combustion air on the thermal performance of counterflow regenerators have been studied. Based on its merits, the Alternating Direction Approximation has been selected for the purpose.

Experiments have been carried out to calculate the convective heat transfer coefficients in a regenerator model. For the limited range of velocities and temperatures for which the experiments are conducted, the values of heat transfer coefficients obtained from experiments compare favourably with the corresponding published data.

The Dufort and Frankel scheme has been developed for the numerical integration of the one-dimensional regenerator model. The thermal ratios calculated for various cases agree very closely with those obtained from other methods. It has been shown that this integrating scheme, for one-dimensional model, requires only two-third of computer time, as compared to the trapezoidal method, with only a little sacrifice on accuracy.

Alternating Direction Approximation and Dufort and Frankel schemes have been developed for two-dimensional regenerator model. The thermal performance of regenerators has been evaluated for a large number of regenerator data.

It is shown that the Alternating Direction Approximation is superior to the Dufort and Frankel scheme for the two-dimensional model.

The two-dimensional model and the Alternating Direction Approximation are employed to study the effects of injecting 0-15 percent steam, by volume, to combustion air on the regenerator performance. It is established that adding small quantities of steam improves the regenerator performance and results in considerable saving in fuel requirements of the furnace. The optimum value of steam quantity to be added depends upon the regenerator operating and design parameters. It is predicted that a furnace using 60 **Scms** air, in some cases, can save upto 5 million rupees per annum by adding 10 per cent steam to combustion air.

A non-linear model is proposed for studying the effect of steam addition on regenerator performance and the consequent fuel savings. The results obtained from the linear and the non-linear models are compared. It has been shown that the linear model predicts considerably low values of the savings in fuel costs, though it requires half the computer time needed for the proposed non-linear model. It is recommended that for better accuracy in predicting the effects of steam injection on regenerator performance, the non-linear model should be used.

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