CHARACTERIZATION AND PERFORMANCE ANALYSIS OF SOLAR THERMAL COLLECTORS FOR LOW AND MEDIUM TEMPERATURE APPLICATIONS

By

Eng. Ahmed Aboulmagd Shawky Sayed

A Thesis Submitted to the Faculty of Engineering at Cairo University in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

MECHANICAL POWER ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:
Characterization and Performance Analysis of Solar Thermal Collectors for Low and Medium Temperature Applications

Key Words:
Solar Collectors; Parabolic; Compound; Concentrator; Performance; Efficiency; Optical; Thermal; Model

Summary:
The present thesis introduces an investigation of performance for two main types of solar thermal collectors, the compound parabolic concentrators and the parabolic trough collectors, for the use in residential, commercial and industrial applications. These collector types are studied according to the temperature level that can be obtained by utilizing proper geometrical and operating conditions, low temperature (with no or low concentration) and medium temperature (with medium concentration). A generalized mathematical model for optical and thermal behavior of solar thermal collectors is developed and applied to the different collector types. A numerical solution procedure is then proposed and applied to the developed mathematical models. Simulation outputs are validated against experimental measurements and calculations obtained from the available test-runs. Different performance indices are used to assess and compare the performance of different collector types under study.

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DEDICATION

To my mother.

CONTENTS

LIST OF TABLES

LIST OF FIGURES