



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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Under the supervision of:

Prof. Dr. Adel Khalil Hassan

Prof. Dr. Ashraf Saad El-Din Sabry

.....

.....

Mechanical Power Engineering Department
Faculty of Engineering, Cairo University

Mechanical Power Engineering Department
Faculty of Engineering, Cairo University

Prof. Dr. Davide Del Col

.....

Department of Industrial Engineering
The University of Padova, Italy

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Approved by the Examining Committee:

Prof. Dr. Adel Khalil Hassan, Thesis Main Advisor and Member

Prof. Dr. Ashraf Saad El-Din Sabry, Member

Prof. Dr. Mohamed Fawzi El-Refaie, Internal Examiner

Prof. Dr. Mohamed Fatouh Ahmed, External Examiner
(Professor at the Mechanical Power Department, Faculty of Engineering, Helwan University)

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2015**

Engineer: Ahmed Aboulmagd Shawky Sayed
Date of Birth: 8/9/1979
Nationality: Egyptian
E-mail: a.aboulmagd@staff.cu.edu.eg
Phone: +20 33913519; +20 1113298385
Address: Flat # 2, Building # 12, Abdel-Dayem
Abdel-Latif street, Hadayek el-
Koppa, Cairo, Egypt.



Registration Date: 1/10/2012

Awarding Date: / /

Degree: Doctor of Philosophy

Department: Mechanical Power Engineering

Supervisors: Prof. Dr. Adel Khalil Hassan

Prof. Dr. Ashraf Saad El-Din Sabry

Prof. Dr. Davide Del Col (Professor at the Industrial
Engineering Department, Padova University, Italy)

Examiners: Prof. Dr. Adel Khalil Hassan

Prof. Dr. Ashraf Saad El-Din Sabry

Prof. Dr. Mohamed Fawzi El-Refaie

Prof. Dr. Mohamed Fatouh Ahmed (Professor at the Mechanical
Power Department, Faculty of Engineering, Helwan University)

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.

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