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## Performance and Design Optimization of Solar Collectors

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**Abstract:** The objective of the present work was to conduct a comparative analysis of solar collectors. The experimental set-up consists of two flat plate solar collectors, the first collector was with a fixed surface tilted at 30° towards the South, and the second one was equipped with dual-axis rotation system. A programmable chronological tracker was used to control the motion of the moving collector. An experimental programme was performed to investigate the effect of the sun tracking system usage on the collector efficiency. The study includes development of a 3-D mathematical model of the system and extensive numerical simulation, based on the computational fluid dynamics (CFD) approach. The main aim of the modelling is to provide information on heat transfer, and to numerically simulate the heat transfer performances and the energy capture capabilities of the fixed and moving collectors in various operating modes. The comparative analysis shows that there is a good agreement between the experimental and numerically predicted results for different running conditions, and the presented modelling approach can be used for further investigations, including more complex problems.

**Keywords:** Solar collector, Solar energy, Heat transfer

### Introduction

One of the simplest and most direct applications of the solar energy, which is cost effective, is its conversion into heat. It is also one of the ways the residential and other sectors can lessen their share in electricity consumption and impact on the environment. The cost effectiveness of solar thermal collectors depends on the cost of collector components, the efficiency and the thermal losses associated with the collector at the local operating conditions. Flat plate solar water heaters are traditionally in use in domestic hot water systems because of the low temperature requirement and low equipment cost (Sumathy, 1999). Conventional solar water heater systems and solar assisted heat pump systems for hot water production in specific local conditions are presented in (Li & Yang, 2009).

A 3-D numerical model for flat-plate solar collector that considers the multidimensional and transient character of the problem, the effect of the non-uniform flow on the collector efficiency was quantified and the degree of deterioration of collector efficiency was defined by Molero - Villar et al.(2009). Their analysis showed that this deterioration increases with the increase of the flow non-uniformity, although this effect is very limited. The model was verified with a steady-state conditions.

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# Solar Engineering 2003 Proceedings

**Rebecca Campbell-Howe**



## **Solar Engineering 2003 Proceedings:**

Solar Engineering 2003 Mark D. Thornbloom, Scott A. Jones, 2003 *SOLAR ENERGY CONVERSION AND PHOTOENERGY SYSTEMS: Thermal Systems and Desalination Plants-Volume IV* Julian Blanco Gálvez, Sixto Malato Rodríguez, E. Delyannis, Vassilis G. Belessiotis, S. C. Bhattacharya and S. Kumar, 2010-11-20 Solar Energy Conversion and Photoenergy Systems Thermal Systems and Desalination Plants theme in five volumes is a component of Encyclopedia of Energy Sciences Engineering and Technology Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias The Theme on Solar Energy Conversion and Photoenergy Systems Thermal Systems and Desalination Plants with contributions from distinguished experts in the field discusses solar energy renewable energy thermal systems and desalination systems some of which are already in commercial and practical applications and others are under research and testing level The volumes provide an analysis and discussion about the reasons behind the current efforts of our society considering both developed and developing countries to accelerate the exploitation of the huge solar energy potential in our normal daily lives The five volumes also provide some basic information about the solar energy potential history and the amazing trip of a photon from its creation in the Sun until its arrival to the Earth These five volumes are aimed at the following five major target audiences University and College Students Educators Professional Practitioners Research Personnel and Policy Analysts Managers and Decision Makers NGOs and GOs

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### **Table of Contents Solar Engineering 2003 Proceedings**

1. Understanding the eBook Solar Engineering 2003 Proceedings
  - The Rise of Digital Reading Solar Engineering 2003 Proceedings
  - Advantages of eBooks Over Traditional Books
2. Identifying Solar Engineering 2003 Proceedings
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Solar Engineering 2003 Proceedings
  - User-Friendly Interface
4. Exploring eBook Recommendations from Solar Engineering 2003 Proceedings
  - Personalized Recommendations
  - Solar Engineering 2003 Proceedings User Reviews and Ratings
  - Solar Engineering 2003 Proceedings and Bestseller Lists

5. Accessing Solar Engineering 2003 Proceedings Free and Paid eBooks
  - Solar Engineering 2003 Proceedings Public Domain eBooks
  - Solar Engineering 2003 Proceedings eBook Subscription Services
  - Solar Engineering 2003 Proceedings Budget-Friendly Options
6. Navigating Solar Engineering 2003 Proceedings eBook Formats
  - ePub, PDF, MOBI, and More
  - Solar Engineering 2003 Proceedings Compatibility with Devices
  - Solar Engineering 2003 Proceedings Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Solar Engineering 2003 Proceedings
  - Highlighting and Note-Taking Solar Engineering 2003 Proceedings
  - Interactive Elements Solar Engineering 2003 Proceedings
8. Staying Engaged with Solar Engineering 2003 Proceedings
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Solar Engineering 2003 Proceedings
9. Balancing eBooks and Physical Books Solar Engineering 2003 Proceedings
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Solar Engineering 2003 Proceedings
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Solar Engineering 2003 Proceedings
  - Setting Reading Goals Solar Engineering 2003 Proceedings
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Solar Engineering 2003 Proceedings
  - Fact-Checking eBook Content of Solar Engineering 2003 Proceedings
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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