Flat Plate Solar Collectors And Their Application To Dwellings

The performance of solar domestic hot water (SDHW) systems utilizing flat-plate solar collectors is optimized for Beirut climate with respect to many design parameters. The Beirut hourly climatologicaf data is used to solve for the system characteristics: absorbed solar energy, useful heat gain, storage tank temperature distribution, system efficiency and relevant parameters. A computer simulation code is designed to solve SDHW systems and evaluate system performance. Optimization of flat-plate solar collectors is done with respect to the following parameters: surface azimuth angle (orientation), angle of tilt, absorber plate emissivity and number of glass covers. Optimal performance is obtained for a South facing solar collector all the year with an angle of tilt equal to latitude-15° in summer and equal to latitude4 15° in winter. A collector with a selective surface would always give better performance than that with a non-selective surface. A collector with a selective surface with a single glass cover would give better performance than that with a double glass cover, while, a collector with a non-selective surface with a double glass cover would give better performance than that with a single glass cover. A parametric study of a thermosiphon SDHW system is performed with respect to the following parameters: 1) the ratio of storage tank volume to collector area, 2) the ratio of storage tank length to its diameter, 3) the vertical distance between the bottom of storage tank and the top of collector, 4) the position of storage tank axis (vertical or horizontal) and 5) the diameter of connecting piping. Results have shown that these parameters affect the mass flow rate of the system but the mass flow rate itself has insignificant influence on the system performance. However, some parameters still affect the performance of the system. Hourly performance for different systems is studied. Finally, Experimental verification and testing of a commercial SDHW system is performed and the results are compared with computer simulation code results.

An analytical and experimental program was conducted to develop an optimized transparent plastic honeycomb for use in a flat-plate solar collector system. Analysis was performed on both low- and high-temperature candidate plastics from the point of view of ease of manufacture, performance, and total cost. Detailed testing was performed on two candidate honeycomb materials - Mylar and Lexan - using Glass, Tedlar, and Teflon as the cover materials. Although a Teflon system gave a high collector performance, difficulty in manufacture and high material costs ruled out the possible economical use of the system at present. The Lexan/Glass and Lexan/Tedlar system of honeycomb/cover gave similar results which were higher than those for the Mylar systems. A thermal protection technique was developed for the 'coolant stagnation' situation, in which the honeycomb was raised above the absorber plate surface.

The aim of this research project is to improve the thermal performance of passive flat plate solar collectors using a novel cost effective enhanced heat transfer technique. The project work focuses on the process of energy conversion from the collector to the working fluid. This is accomplished by employing an aluminium grid placed in the channels of a collector to induce a gradient of heat capacitance. This novel technique is tested both theoretically by means of simplistic designs using Computational Fluid Dynamics (CFD) and experimentally using two unglazed collectors. One collector has the aluminium net inserted in its channels and it is tested against an identical conventional collector in order to have a direct comparison at the same time. The obtained CFD data and the experimental findings are coupled and show a good agreement. All the obtained results are validated with the literature. The results both theoretical and experimental demonstrate an enhancement in the heat transfer coefficient by 9 % resulting to an increase in the output temperature of the working fluid in the collector with the metallic insertion. Other parameters such as the Nusselt and Raleigh numbers supported these findings. Three novel expressions that correlate the Nusselt and the Rayleigh number, for different heat fluxes, were developed using data from CFD and experimental results. These correlations can be applied on any flat plate collector with an aluminium grid in its pipes, in order to predict its performance. Furthermore an existing lumped parameters model that predicts the output temperature of a collector was simplified and improved.

[An Investigation Into Flat Plate Solar Collectors]
[Reliability and Durability of Flat Plate Solar Collectors]
[Provisional Flat Plate Solar Collector Testing Procedure]
[Metal Foil Selective Surfaces on Flat Plate Solar Collectors]
[Low Temperature Conversion of Solar Energy]
[Development of Flat-plate Solar Collectors for the Heating and Cooling of Buildings]
[Outdoor Testing and Mathematical Modelling of Flat-plate Solar Collectors]
[Uncertainty in Determining Thermal Performance of Liquid-heating Flat-plate Solar Collectors]
[Development of a Flat-plate Solar Collector Design Program]

Derivation of Plate Efficiency Factors for Flat Plate Solar Collectors of the Pipe and Fin Type

The updated fourth edition of the "bible" of solar energy theory and applications Over several editions, Solar Engineering of Thermal Processes has become a classic solar engineering text and reference. This revised Fourth Edition offers current coverage of solar energy theory, systems design, and applications in different market sectors along with an emphasis on solar system design and analysis using simulations to help readers translate theory into practice. An important resource for students of solar engineering, solar energy, and alternative energy as well as professionals working in the power and energy industry or related fields, Solar Engineering of Thermal Processes, Fourth Edition features: Increased coverage of leading-edge topics such as photovoltaics and the design of solar cells and heaters A brand-new chapter on applying CombiSys (a readymade TRNSYS simulation program available for free download) to simulate a solar heated house with solar-heated domestic hot water Additional simulation problems available through a companion website An extensive array of homework problems and exercises

This manual describes the type of collector thermal performance information which is required in active system design and analysis. It also contains thermal performance test data on 109 commercially available solar collectors which were evaluated in a single, uniform test program, the Interim Solar Collector Test (ISCT) Program. In addition to recounting the ISCT program and its results, the manual contains an introduction on the engineering and physics of a flat-plate solar collector operation. A step-by-step analysis of heat gains and losses is provided to help the reader understand both the source and applicability of the parameters used to describe collector thermal performance. A brief description of the engineering basis for the ASHRAE Standard 93-77 test procedure and the method are included. To demonstrate the sensitivity to variation of collector performance parameters of the annual output of representative solar heating systems, three sets of F-Chart (4.0) system performance predictions are given. Finally, a sensitivity analysis study is presented which considers the heat loss and optical gain parameters of flat-plate collectors, in terms of how they affect the overall solar heating system solar fraction.

Solar thermal systems available today offer efficiency and reliability. They can be applied in different conditions to meet space- and water-heating requirements in the residential, commercial and industrial building sectors. The potential for this technology and the associated environmental benefits are significant. This book offers clear guidance on planning and installing a solar thermal system, crucial to the successful uptake of this technology. All major topics for successful project implementation are included. Beginning with resource assessment and an outline of core components, this guide details solar thermal system design, installation, operation and maintenance for single households, large systems, swimming pool heaters, solar air and solar cooling applications. Details on how to market solar thermal technologies, a review of relevant simulation tools and data on selected regional, national and international renewable energy programmes are also provided. In short, the book offers comprehensive guidance for professionals who wish to install solar thermal technology and will be a cherished resource for architects and engineers alike who are working on new projects, electricians, roofers and other installers, craftsmen undertaking vocational training and anyone with a specialized and practical interest in this field. Published with DGS

Standards for Cover Plates for Flat Plate Solar Collectors (Classic Reprint)

A Guide for Installers, Architects and Engineers

Flat Plate Solar Collectors and Their Application to Dwellings. -Low Temperature Conversion of Solar Energy-

An Investigation of Monthly-average Utilizability for Flat-plate Solar Collectors

Final Report

Analysis of Flat-plate Solar Collectors with Radiatively Selective Thin-film Coated Cover Plates

A Method for Sizing Flat Plate Solar Collectors for Space and Hot Water Heating

Optimization of Thin-Film Transparent Plastic Honeycomb Covered Flat-Plate Solar Collectors. Phase 2

Flat plate solar collectors and their application to dwellings

Introductory technical guidance for mechanical engineers and other professional engineers interested in solar collectors. Here is what is discussed: 1. INTRODUCTION 1.1 SCOPE 1.2 RELATED CRITERIA 1.3 SOLAR ENERGY 2. FLAT PLATE SOLAR COLLECTORS 2.1 COLLECTORS 2.2 ENERGY STORAGE AND AUXILIARY HEAT 2.3 DOMESTIC HOT WATER SYSTEMS (DHW) 2.4 THERMOSYPHON, BATCH AND INTEGRAL COLLECTOR SYSTEMS 2.5 SPACE HEATING AND DHW SYSTEMS 2.6 PASSIVE SYSTEMS 2.7 SOLAR COOLING SYSTEMS 2.8 SYSTEM CONTROLS.

Various methods of characterising the performance of flat-plate solar collectors are being investigated at the CSIRO Division of Mechanical Engineering. This report describes procedures used to evaluate two important collector characteristics by two separate experiments. The first of these, an overall heat transfer coefficient between fluid and ambient air, is determined by measuring the heat lost from a collector supplied with hot water by natural circulation from an external electric heater. The heat transfer rate is determined as a function of air speed and the mean temperature difference between water and ambient air with the collector mounted in a test room. The second characteristic is a solar absorption factor which is determined from an experiment in direct sunlight. The absorption factor includes implicitly such items as the solar optical properties of glass covers and absorber plate, "fin efficiency" and the ratio of the absorber plate area to the plan area of the collector. Results are presented for five types of flat-plate collectors.

Excerpt from Solar Energy Systems: Standards for Cover Plates for Flat Plate Solar Collectors Heat Stability Aging Procedure Artificial Weathering with Xenon Arc Light Natural Weathering Exposure. About the Publisher Forgotten Books publishes hundreds of thousands of rare and classic books. Find more at www.forgottenbooks.com This book is a reproduction of an important historical work. Forgotten Books uses state-of-the-art technology to digitally reconstruct the work, preserving the original format whilst repairing imperfections present in the aged copy. In rare cases, an imperfection in the original, such as a blemish or missing page, may be replicated in our edition. We do, however, repair the vast majority of imperfections successfully; any imperfections that remain are intentionally left to preserve the state of such historical works.

Improvements to flat plate solar collectors for heating and cooling of buildings were investigated through two parallel studies. The first study, which deals with the free convective heat loss from V-corrugated absorber plate to a plane glass cover, has shown that, for the same average spacing, the free convective heat loss is greater for a V-corrugated absorber plate than for a plane absorber plate. However, provided the average spacing is large enough, the amount of increase is slight. The second study, which deals with the free convective heat loss in a honeycomb solar collector in which the honeycomb consists of a set of horizontal partitions, or slits, has shown that provided the solar collector is tilted to near vertical, such a honeycomb gives equivalent or superior free convective loss suppression than does a square-celled honeycomb having the same amount of material. Correlation equations for the free convective heat loss are given for both studies.

Excerpt from Weathering Performance of Cover Materials for Flat Plate Solar Collectors Solar Energy Transmittance of Cover Plate Materials After Exposure as Single Covers to Natural Weathering in Miami. About the Publisher Forgotten Books publishes hundreds of thousands of rare and classic books. Find more at www.forgottenbooks.com This book is a reproduction of an important historical work. Forgotten Books uses state-of-the-art technology to digitally reconstruct the work, preserving the original format whilst repairing imperfections present in the aged copy. In rare cases, an imperfection in the original, such as a blemish or missing page, may be replicated in our edition. We do, however, repair the vast majority of imperfections successfully; any imperfections that remain are intentionally left to preserve the state of such historical works.