HIGHER TECHNICAL INSTITUTE

MECHANICAL STUDIES DEPARTMENT

DIPLOMA PROJECT

PERFORMANCE TESTING OF THERMOSYPHON SOLAR WATER HEATER

By

GEORGIOU GEORGE
((M/746)

JUNE 1996

PERFORMANCE TESTING OF THERMOSYPHON SOLAR WATER HEATER

by

GEORGIOU GEORGE

Project Report

Submitted to

the Department of Mechanical Engineering

of the Higher Technical Institute

Nicosia-Cyprus

in partial fulfiltment of the requirements

For the diploma of

TECHINICIAN ENGINEER

in

MECHANICAL ENGEERING

June 1996

TO MY FAMILY AND TO

MY FRENDS COSTA,

DEMITRI , CHRIS AND

TO A SPECIAL GIRL

NAMED MARIA.

CONTENTS

CHAPTER 3: PARAMETERS WHICH INFLUENCE THE PERFORMANCE OF A THERMOSYPHON SOLAR WATER HEATING SYSTEM

CHAPTER 4: SHORT TERM SYSTEM TEST METHOD

SYMBOLS

The symbols given in ISO 9459-1 and the following symbols apply.

a1, a2, a3	Collector performance coefficients
Cpw	Specific heat capacity of water
H	Solar irradiation at collector aperture MJ/m
m	Mass from rate Kg/S
Qcol	Solar energy collected by the collector MJ
Qload	Energy content of hot water load MJ
Ta	Ambient air temperature°C
Tc	Cold water temperature°C
Td	Temperature of water drawn off from the store
Tf	Final temperature°C
Th	Hot water temperature°C
Ti	Collector inlet temperature°C
U	Overall heat loss coefficient of collector
U″	Combined heat loss coefficient of collector and store W/cm K
Us	Store heat loss coefficient W/K

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation and gratitude to my project supervisor Dr. I. Michaelides for his valuable assistance and guidance in the preparation and completion of this project.

I would like to thank everyone that helped me in anyway in producing this project.

PERFORMANCE TESTING OF A THERMOSYPHON SOLAR WATER HEATER

Written by: Georgiou George

Summary

The objectives of this project are:

1) To study the ISO standard on the procedures for performance characterisation and yearly performance prediction of solar water heating systems.

2) To identify the parameters affecting the performances of a thermosyphon solar water heating system.

3) To carry out experimental tests and investigate the performance characteristics of a thermosyphon solar water heater, using the method described in ISO 9459-2.

4) To analyse the test results and, if possible, compare them with simulation results.

The tests werè conducted at the Applied Energy Research of the Ministry of Commerce, Industry and Tourism.

INDRODUCTION

The benefits obtained by the utilization of solar energy, were recognized by humans at their earliest stages of civilazation. This is evident from history documents were for example the Greek philosopher Socrates, is seen to teach his student how to build and orient their houses in order to have better exploitation of solar energy.

During the last decades the demand for more energy has increased dramadically. As a result of this, the rate of consumption of the finite sourses of convectional fuels has also increased and their prices are continuously rising. These and other factors as the enviromental pollution, caused by the conventional sources of energy, have forced sientists to find ways of affective utilization of the renewable, non polluting and plentiful source of solar energy. Therefore, today a lot of designs exist for the collection and conversion of solar energy so that, it can be used to produce electricity, heat spaces, drive vehicles and in quite a lot of other applications.

The most common use in Cyprus is the heating of water for domestic use, whish is be found in Cyprus from the ancient years. However the adoption of specific and more efficient methods of heating up the water are located near the 1900 a.s with the use of the tuurkish bath called the "hamman". The existance of such a bath in a house was a privilege for the owner.

In 1940's the well known hot water wood cautery (a cloced cylinder with an intergrater combustion chamber underneath were pieces of wood were

used for combustion). Near 1955 the first hot water electric heater appeares in the Cyprus market. However, it's high cost constrained it's expanded usage, in those years.

In 1968 the common domestic thermosyphonic systems were imported from developed countries. Since the demand for it increased and some Cypriot manufacturers started to produce and install them. Solar water heating with Thermosyphon Solar Water Heating Systems are considered a very attractive application of solar energy, and in many locations it is an economically competitive option. These are mainly the reasons for which thermosyphonic water heating systems have gained popularity in many countries. In Cyprus, for example, it is estimated that there are more than 130,000 units in operation, which means one solar water heater for every five people on the island. According to construction and housing statistics for 1987, about 87% of new buidings have been equipped with solar water heaters, as compared to 69% in 1982. The cost effectiveness of a thermosyphon solar water heater is dependent upon to major factors: the cost of convectional sources of energy used for domestic water heating and the solar fraction of the hot water load supplied by solar energy. However, the solar fraction is dependent upon metereological conditions, collector type, collector area and arrangement, annual load and load consumption profits, which differ from place to place.