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EVALUATION OF THE PERFORMANCE OF THERMOSYPHON SOLAR WATER HEATER

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EVALUATION OF THE PERFORMANCE OF THERMOSYPHON SOLAR WATER HEATER

by

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NOMENCLATURE

Symbol	Meaning	Units
Aa	Collector aperture area	m^2
Ag	Collector area	m^2
G	Solar irradiance at collector aperture	W/m^2
Gd	Diffuse solar radiation	W/m^2
Hd	Daily diffuse solar radiation	MJ/m^2
Qout	Useful energy output	MJ
Ta	Ambient air temperature	°C
Tc	Cold water temperature	°C
Td	draw off water temperature	°C
Tf	Finall water temperature of the storage tank	°C
Ti	Initial water temperature of the storage tank	°C
U	Wind speed	m/s
		W/m^2k
Us	Heat loss coefficient of storage vessel	W/K
Vs	Storage tank volume	Liter
n	Collector thermal efficiency	-
Dt	Duration	s
Htilt	Monthly average daily irradiation on the collector	MJ/m^2
Ta,av	Monthly average daily (24 h) ambient temperature	°C
Tref	Water temperature which is draw off	°C
FrUl	Slope of the collector efficiency curve	
Fr(τa)n	Intercept of the collector efficiency curve	-
Gtest	Collector flow rate per unit area of collector at test conditions	kg/m^2h
Nr	Number of parallel collector risers	-
Paux	Auxiliary energy input to tank	Kw
β	Collector tilt angle	°

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SUMMARY

The objective of this project was to use the cyprus standard CYS:209:91 for performance characterisation and yearly performance of atypical Cypriot thermosyphon water heater.
The upcoming steps were followed for the completion of this project:

[1] First of all, a review study was done about different types of solar domestic hot water system employed in Cyprus.

[2] Then, a general review was carried out of the performance of a thermosyphon solar water heater such as collector, and collector efficiency , storage tank e.t.c.

[3] Furthermore, the parameters affecting the performance of a thermosyphon were analysed.

[4] Next, the term short system test method with results and draw off profiles were conducted. The results obtained from the short term test (4 days with daily solar irradiation in the range 15-25 $MJ/m^2$and 2 days with daily solar irradiation in range 0-15 MJ/m) ie the performance characteristics of the system were independent of the location of the test.

[5] The final results of the test procedure and long term performance prediction were presented so that they can be easily understood by consumers and manufactures, in terms of anual energy savings (KWh/year). A procedure was therefore developed which used the results of the short term test to predict the long term performance of thermosyphon water heater.

The procedure described by the Cys:209 for experimentally

predicting the performance of SDH produces results which are not site specific and therefore are valid everywhere provided the local climatic conditions are known. AS the method is the same used in Greece and other European countries local SDH manufactures will be in position to take advantage of opportunities which arise in the European market.

- It gives consumers a criterion on which to base their selection of SWHS.
- It provides an indication to manufacturers and prospective buyers on how efficiently the system work. So far there were available test results on collectors and storage tanks but the behaviour of the system could not be characterised by the component test results. The test results can be used to assess the impact of design, insulation and other changes to the system as such.
- The procedure homever required test, thus demanding to a long time and manpower.

INTRODUCTION

Cyprus enjoys excellent weather conditions for the development and utilization of solar energy in all sectors. It was these weather conditions that the cypriot manufactures took advantage of, when in 1960, they began manufacturing in cyprus the first solar heaters. After that, a period of exceptional widespread development of solar energy systems for the domestic sector began as a result of which, today, cyprus with its 227,000 systems installed, is probably the first country in Europe and the mediterranean regarding the number of solar heaters per head. Today 90% of individual houses are equiped with solar heaters ,in contrast to multi-apartment blocks where the percentage is 20%. Multipanel solar systems for the supply of large quantities of hot water were introduced in 1980, as a result of which, today 50% of hotels are equipped with solar systems.Further development of solar energy utilization, in individual houses built before 1965 proved to be rather expensive, because the necessary prerequisites for the installation were not taken into account when they were buit.Furthermore, the lack of methods for freezing protection of solar collectors is still a prohibitive factor for the widespread use for solar systems in the mountainous areas.

The nice weather conditions, the high cost of electricity and the financial benefits that result from the use of solar heaters were the principal reasons that contributed to the decision for the utilization of solar energy, as a result of which, cyprus became one of the first countries in the world with respect to the percentage of energy saved from the use of solar heaters (4%). The government also contributed in many ways towards this effort. One such contribution was the funding of the installation of 11,000 solar heaters installed on refugee housing built in the free part of Cyprus. Furthermore loans were offered to individuals and hotel owners for the installation of such systems. Technical assistance is also provided to the manufacturers including the experimental determination of collector efficiency and the training of manufacturers in design and manufacturing of improved type of the collectors.

The most popular type of solar collector manufactured in Cyprus is the flat plate solar collector.

The fact that Cyprus has perhaps the higher percentage per capital of energy saved from the usage of solar systems in the world should not be a preventive factor for further development. For this to be achieved, the installation of solar heaters, by taking into account provisions, during the construction of multi-apartment blocks, for future installation of solar heaters and by divising ways of utilizing the common area on the roofs.
The state of solar technology in Cyprus today, makes it possible to install solar systems with a high degree of efficiency for preheating water for industrial purposes.