Institute for Energy Technology, University of Malta
Triq il-Barrakki, Marsaxlokk, MXK 1531, Malta

Poster 28

EUROSUN 2008
7-10 Oct. 2008
Lisbon-Portugal

Performance Analysis of Water-in-Glass Evacuated-Tube Solar Heating Systems in Malta

C. Yousif, C. Fernandez Vazquez and V. Buhagiar

Phone: ++ (356) 21650675, Fax: ++ (356) 21650615
E-mail: charles.yousif@um.edu.mt
Website: http://staff.um.edu.mt/cisk1

1. Introduction

The domestic sector in Malta widely utilises electric boilers to heat water. With the introduction of fuel surcharge on electricity and water bills, the cost of heating water has risen dramatically.

The National Census of 2005 showed that only 5,010 solar heaters were installed in homes, covering a mere 3.6% of Maltese households. Government incentives to give capital grants of up to 25%, has increased the uptake of solar heaters to some extent and is now estimated to have reached 12,000 units.

2. The Housing Authority Initiative

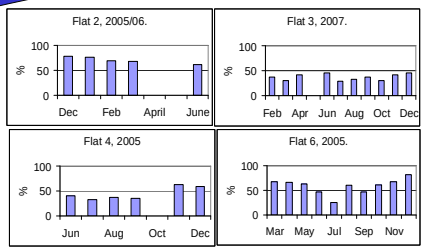
The Housing Authority took the initiative to build the first Energy Saving Social Housing Project at *Tal-Ftieh*, Birkirkara, Malta. This was mainly comprised of two adjacent blocks with a total of 10 apartments and 1 showroom.

3. Solar Heating at *Tal-Ftieh* Housing Project

1. 150-litre capacity each, considered to be sufficient for the washing needs of a family of four.
2. Evacuated-tube systems were chosen due to the limited space, as they would occupy less area than an equivalent flat-plate solar system.
3. Electronic controller and display unit allowed a better control of hot water usage and gave a full picture of the system's conditions at one glance.

4. Efficiency of the Solar Systems

Although all apartments had the same number of occupants (2 adults each), the efficiency of the solar systems varied dramatically between 30 and 80%. This was mainly caused by the different lifestyles and the amount of hot water consumed. Higher efficiencies implied that hot water was being used in larger quantities, giving the chance for cooler water to absorb more energy from the sun. On the other hand, lower efficiency systems were associated with careful users of hot water. It was interesting to note that all users were satisfied with the performance of their systems and had sufficient hot water without reverting to the electric back-up heater. This was purposely disconnected throughout the data acquisition period. Hence the 'efficiency' term could confuse lay persons.



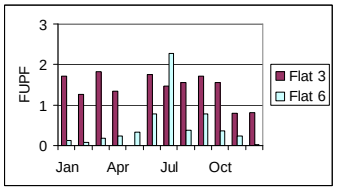
5. Future Utilisation Potential Factor (*FUPF*)

In order to translate the technical results of efficiency into an easy-to-understand term, which would not alarm the users but give a proactive impression of their system, a new term had to be defined as:

$$FUPF = \frac{\eta_{max} - \eta_{month}}{\eta_{month}} \quad \text{, for } >0$$

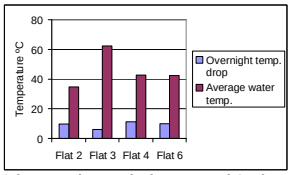
Where, *FUPF* = Future Utilisation Potential Factor, which gives the ratio of hot water reserved for future use to current hot water consumption, for a specific period.

A comparison was made between the *FUPF* values of Flats 3 and 6, which had complete data sets of at least 1 year each. It is shown that even though both owners were satisfied with the performance of their systems, it was apparent that Flat No. 6 had virtually no *extra* hot water storage during most months, while Flat No. 3 had up to almost twice the amount of hot water used, in reserve. This is a direct result of proper management of hot water usage, which was facilitated by the electronic control unit and the interest of the users to follow the daily weather forecast.



6. Other Tests: Overnight Temperature Drop

Flat 3, which was the best managed apartment had the lowest overnight temperature drop, even though the average temperature in the tank was the highest.



7. Other Results: Typical Usage and Savings

Hot Water Needs for Normal Usage = 30 litres/person/shower
Potential Energy Saving = 1,650 kWh thermal/system/annum
Carbon Dioxide Savings = 1.6 tonnes/system/annum
Days with Insufficient Hot Water = 5-15 days/year

8. Conclusions

1. Sizing solar systems should take into consideration, not only the number of persons in the residence, but also their washing habits (showers or baths), their specific requirements (connection of solar hot water to kitchen, washing machine, etc..), the number of days for hot water storage, as well as the inclusion of the *FUPF*, which caters for any future increase in hot water demand.
2. Savings do not come automatically with installation of a solar system. In fact, misuse of the solar heating system could at times, lead to higher electricity bills.
3. It is recommended that dealers should start providing instruction and troubleshooting manuals, be more accessible and quick to respond to after-sales services and where possible, offer maintenance contracts. Only then would customer satisfaction be improved and more solar systems be installed on the island.