

ABSTRACT

The main disadvantage of solar thermal systems used for heating domestic hot water is the fact that they freeze during periods of low temperature and consequently their pipes can break. In this thesis this barrier is going to be overcome by designing and experimentally characterizing a prototype solar collector based on heat pipes. The main characteristic of this kind of systems is that due to the fact that they do not use water as heat transfer medium but use proper chemical substances with very low freezing points they achieve to eliminate the problem of freezing and breaking of the pipes.

The first stage was a theoretical study and a literature review where two heat transfer mediums were chosen; acetone and methanol. Consequently, the experimental characterisation of the solar collector took place in outdoor conditions by properly recording several variables like inlet and outlet water temperatures, ambient temperature, volumetric flow of water and incident solar radiation. During the experimental procedure a prototype solar collector was used together with a 50lt water storage tank and all necessary equipment such as data acquisition devices, tubing, circulator, ball valves etc. One of the main parameters to be examined was the heat transfer medium volume to be inserted to the system which after an extended literature review and a series of theoretical calculations was decided to be 1000ml which is the 30% of the total volume of the heat transfer circuit.

During the experimental procedure two series of experiments were carried out, one for each medium, lasting three days in order to have repeatable results. The results of this work were plotted graphically to form the characteristic curve of the solar collectors' efficiency and were compared to the curve of a typical water solar collector plotted by the responsible service of the Ministry of Industry, Tourism and Commerce. The two curves drawn had the same trend of efficiency like the typical one; with acetone having a little lower efficiency and methanol having higher efficiency than the typical.

From the results of this work it can be concluded that this type of solar collectors seem to be a very promising technology when used with the heat transfer mediums examined.