Pump Speed Optimisation for Solar Thermal System

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INTRODUCTION

Photovoltaic and solar thermal systems gather the inexhaustible energy from the sun, while reducing to need for fossil fuels and have consequently known an increasing. Quite often these systems are used in standard setups, while further optimization could lead to more efficient energy gathering. For example, solar thermal systems have multiple heat exchangers and optimizing for both heat exchangers leads to better heat transfer and system efficiencies.

EXPERIMENTAL/THEORETICAL STUDY

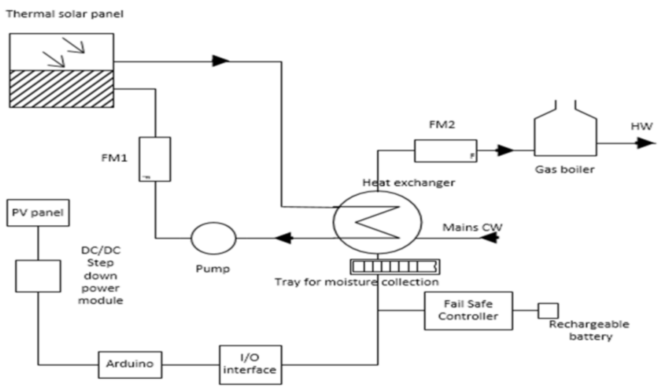

Fig. 1 Block diagram of a solar hot water system

The solar system (shown in Fig. 1) measures at various points, namely: the temperature at: 1) the solar collector inlet (T_{cin}), 2) the solar collector outlet (T_{cout}), 3) the heat exchanger inlet (T_{ein}), 4) the heat exchanger outlet (T_{eout}), and the flow rate of the solar fluid (FM_1) and the hot water (FM_2).

These measured parameters form the input to a formula that is used to calculate the optimal pump speed in real time. Within this formula each parameter is combined with a constant that allows the speed to be optimised for all usage and environmental conditions.

RESULTS AND DISCUSSION

Together with the real-time calculation the system also logs all measured values, and the following results are based on 7 months of data, taken during a reasonably mild UK winter. This data was analysed and Fig. 2 shows the variation of the circulating pump speed with relation to the water demand during September 2016.

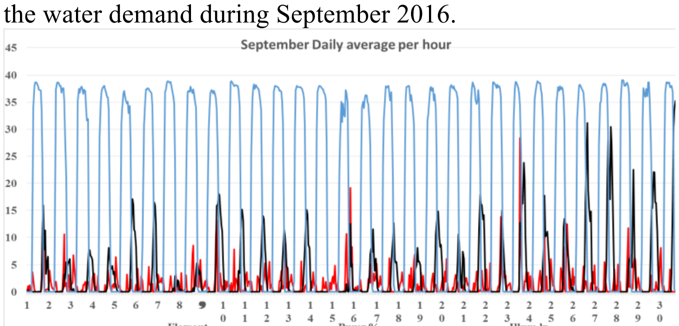

Fig. 2 Measured daily average Pump speed / Flow out values

One can clearly notice the circuit's demand variations between day and night, which leads to pump speed variations to ensure optimal heat exchange within the system. These changes are however not directly proportional due to the introduced optimisation parameters.

An important parameter within the formula is dT, which represents the difference between the temperature at the solar collector outlet (T_{cout}) and the heat exchanger outlet (T_{eout}). The variation of the pump speed with dT is shown in Fig. 3.

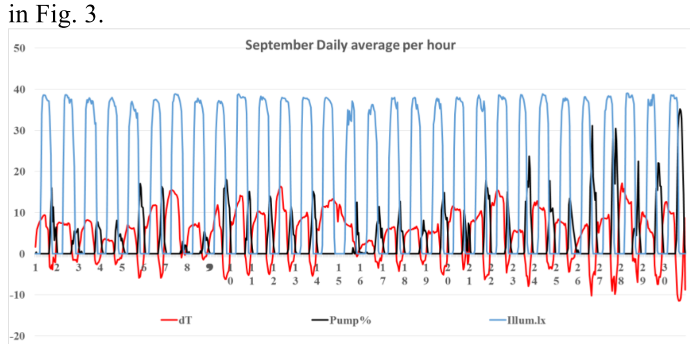

Fig. 3 Measured daily average Pump speed / dT values

dT values can be negative especially during the night when T_{cout} becomes smaller than T_{eout}. However, one can also notice that as illumination builds up, the temperature in the system builds up, unless if the pump switches on for use.

CONCLUSION

The paper indicates that due to the many parameters in a solar thermal system it is essential to consider these when optimising the system, as there are clear relationships between solar illumination, heat gathered and actual consumption. Adjusting the pump speed does not only allow for more efficient heat exchange, but also reduces energy consumption, while the overhead to adjust this pump speed in real time is minor.

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