RESEARCH OF SOLAR ENERGY AT THE FACULTY OF ENGINEERING UNIVERSITY OF SZEGED

PETER SZABO ISTVAN, SZABO GABOR

Department of Process Engineering, Faculty of Engineering, University of Szeged
H-6724 Szeged, Mars ter 7, Hungary
e-mail: pszi@mk.u-szeged.hu

ABSTRACT - Research of Solar Energy at the Faculty of Engineering University of Szeged
At the Faculty of Engineering and it's legal predecessor – the College Faculty of Food Engineering – we research the utilizing of solar energy since 2004. In our narrower region – the south of the Great Hungarian Plain – the utilizing of solar energy could be advantageous, therewith in our new building we will be able to study the utilization of geothermal heat. With our new equipment we can measure the efficiency and analyze the transient effects of solar collectors.

Keywords: Renewable Resources, Solar Energy, Solar Collector, Collector Efficiency

INTRODUCTION

Hungary has good capabilities for the application of renewable resources. There is a high amount of geothermal energy, and in our narrower region – the south of the Great Hungarian Plain – the utilizing of solar energy could be advantageous: the average annual sunshine is 2000-2200 hours.
In the period from April to October in Hungary it is absolutely advisable to utilise the solar energy (DEZSŐ FODOR, 2010).
We can conclude that in the south-eastern part of Hungary and in the surrounding areas over our borders there are favourable possibilities for the utilisation of solar energy primarily in the field of thermal use. The potential solar energy enables a significantly more intensive utilisation primarily in those areas where the energy demand coincides with the summer maximum values of the radiance energy, such as fodder drying or solar cooling – air-conditioning (DEZSŐ FODOR, 2010).
In many industrialized countries, including the US, the heating, cooling, ventilation and lighting of buildings represent approximately 40% of the annual nation's energy consumption (HARTKOPF, 1994).

MATERIAL AND METHOD

Using our prior experiences we have designed a newer experimental measuring system in 2010:

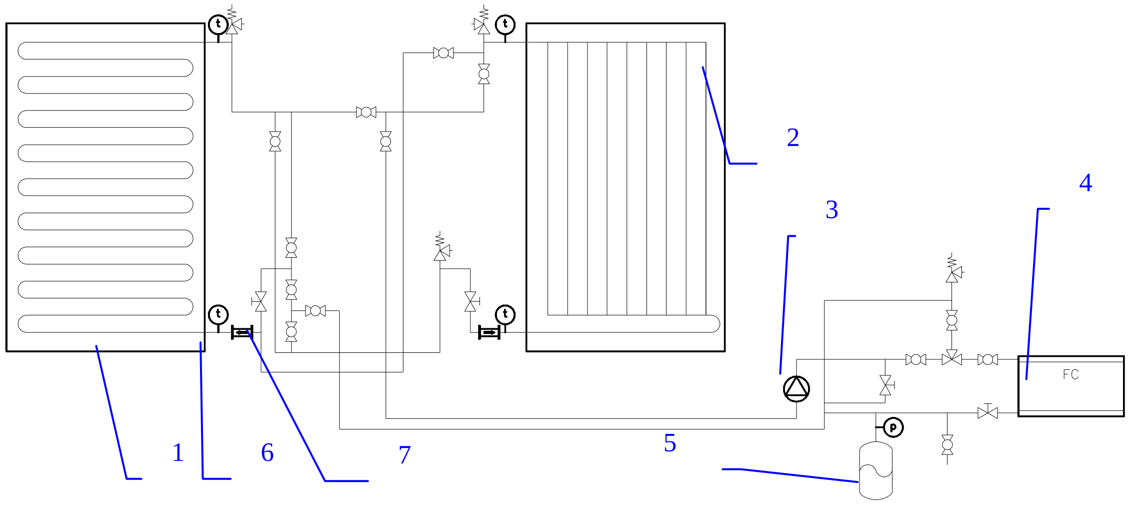

Figure 1. Experimental equipment for measuring the efficiency of solar collectors. 1 – collector with coil-pipe, 2 – collector with parallel pipes, 3 – circulation pump, 4 – fancoil, 5 – expansion tank, 6 – thermometers, 7 – volume flow rate measuring

We used our own-designed collectors. The covering of these collectors is removable, so we could test the collectors with different polycarbonate sheets and uncovered. With the unit we can operate the collectors in parallel or serial connection. In the serial connection we can change the order of the two collectors. It is possible to lock out either collector.

Figure 2. Experimental solar equipment

The equipment transfers the heat output of the collectors to the external air by a fancoil. The cooling fan can be adjusted continuously. The cooling capacity can be decreased further with a bypass pipe.

The circulation pump is adjustable in five steps. In function of the return temperature the pump does further adjusting.

The temperatures were measured by K-type thermocouples with two Testo 177-T4 datalogger. The accuracy of the measuring is ± 0.3 °C.

We measured the temperature and humidify of the external air and the solar irradiation. The irradiation was measured by a Lambrecht 16131 pyranometer mounted between the collectors in the same plane.

RESULTS

Fig. 3 represents the results of a diurnal measuring. *Fig. 4* shows the results of the efficiency calculations for the same day.

As we can see, the cloudy period between 16:30 and 17:30 does not give correct results of efficiency. It is occured by the different reaction time of the collectors and the pyranometer. The pyranometer answers the decrease of the solar irradiation more quickly than the collectors. (The mass of the pyranometer is much lower than the collectors, as you can see on the *Fig. 2*.)

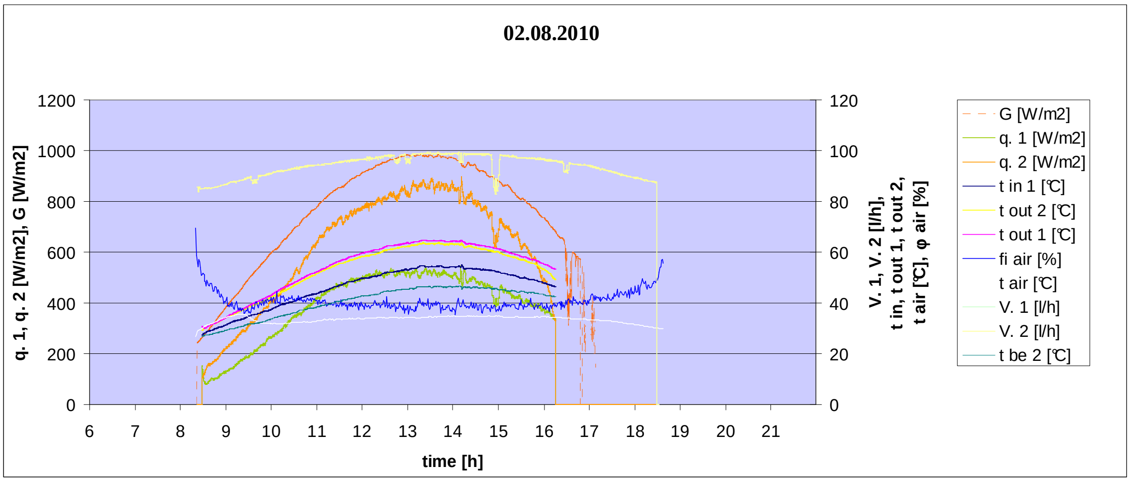

Figure 3. Results of a diurnal measuring

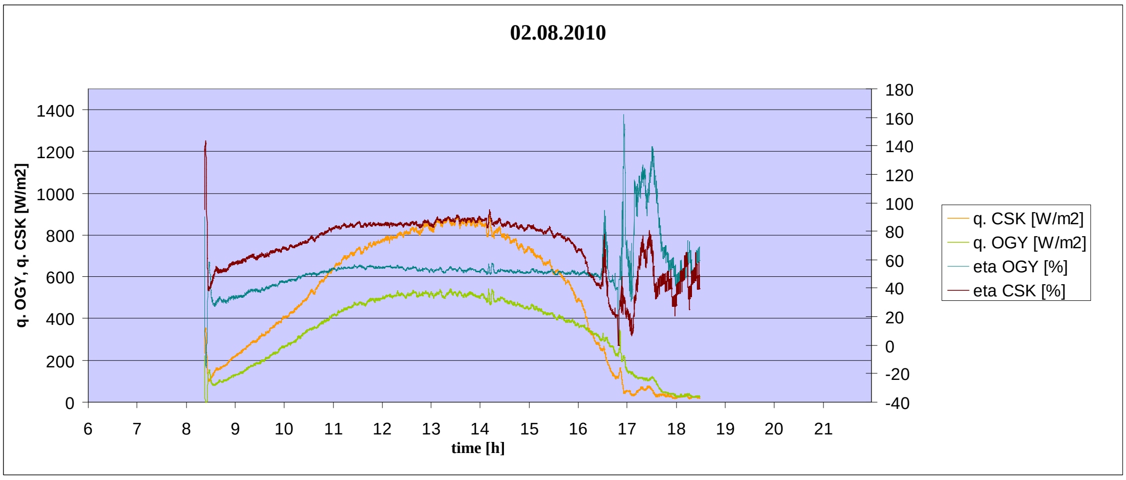

Figure 4. Heat output and efficiency results of a diurnal measuring

During the most of the measuring we have saved the datas by 5 sec. It enables to analyze the transient processes. It results very high amount of datas, so it's processing requires a database management software.

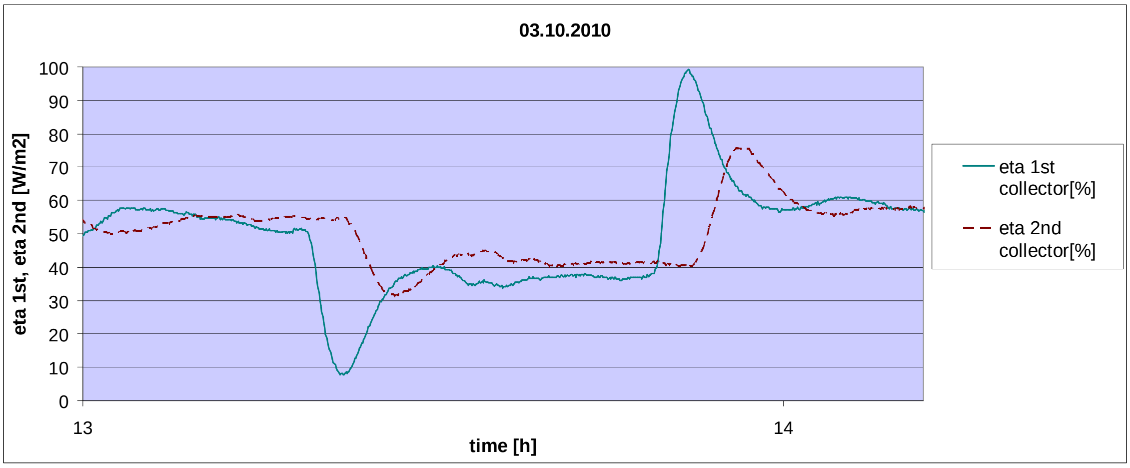

Figure 5. Efficiency changes of the first and second collector in line

As we can see in the *Fig. 5*, the appearance of the changes in the heat output is quicker on the first collector and slower on the second collector in line. After the measuring we have changed the order of the two collectors connected in line, and the effect was the same: the reaction of the second collector was slower:

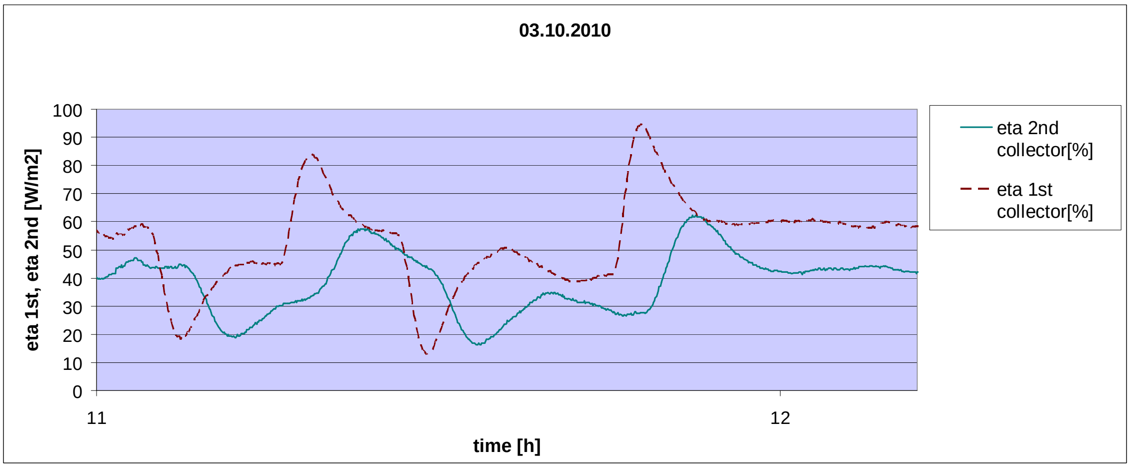

Figure 6. Efficiency changes of the first and second collector in line

SOLAR COLLECTOR, SOLAR CELL AND GEOTHERMAL HEAT PUMP SYSTEM IN THE NEW BUILDING OF THE FACULTY

The acceptance of the building was in March, 2011. The heating, the domestic hot water and the lighting system uses renewable resources.

The heat demand is supplied by two geothermal heat pump with blow pipes. The natural gas used only to aid the heating if it is necessary.

The solar collectors join to the domestic hot water system. In summer the collectors can supply the heat demand of the DHW system, in autumn, winter and spring the collector system is a pre-heater of the DHW system.

The lighting and the outer decorative lighting is particularly supplied by the solar cell system.

The controlling system of the building will measure and logging the parameters hereafter:

– temperatures of the blow pipes of the heat pumps,
– temperatures of the heating subsystems,
– temperature and amount of the domestic hot water,
– solar radiation and external air temperature,
– internal temperatures,
– power and efficiency of the solar cells,
– heat output and efficiency of the solar collectors,
– total energy and renewable energy demand of the building.

By the temperature database we will able to optimize the system. We will able to analyse the long term environmental effect of the building and confirm the researches of the geothermal heat pumps.

The building and the database from the controlling system will give a unique possibility to improve the practical education for the mechanical engineering, technical manager, materials engineer, bioengineer and environmental engineer students.

CONCLUSIONS

The measuring datas of solar systems are not reproducible, so we have to do many admeasurement for verification. We use very short interval to save the results, so we can analyze transient effects and can search repeating effects. In this article we represent two effects.

The cloudy perdiods are not suitable to measure momentary efficiency, only average efficiency could be calculated.

The behaviour of a collector connected in line with others changes if we change the position of the collector in the system.

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