

THERMOPOWER OPTIMISATIONS METHODS IN THE THERMOSUN PLANTS WORKING

ENESCU DIANA, HUSSU ADELA, POPA MIRCEA

“Valahia” University of Târgoviște

Abstract: This paper presents the operational factors optimisation of the thermosun plant have placed within Electrical Engineering Faculty from “Valahia” University of Târgoviște. The thermosun plant is an automatic plant by means of a German equipment (its name is Sun-Go); this equipment is necessary for the thermosun applications. The measurements were performed during one week and were computed by a computer, which is necessary for the data hold, and the data processing have calculated in C⁺⁺. By means of these diagrams, it was obtained the optimisation of the operational factors. Regarding the continuous increase of the equivalent fuels price, the arguments for rigging of a building with a thermosun plant are evidently:

- This equipment permits the simplest and most efficient exploitation of the sun power, the saving of the beneficiary costs beginning in the same time with bringing into service of the equipment;
- Generally, the sun power utilisation assures protection to the increase of the power price;
- The sun power is ecological and is necessary for the preservation of the power conventional resources and to the firm decrease of the emissions of the pollutant substances.

Keywords: Solarterm collector, Collector

1. INTRODUCTION

1.1. Basic circuit and the circuit description

For the realisation of the experiments has used the thermo-sun equipmnet (Fig.1.1). The equipment is copmposed by the following components:

- collector;
- heating circuit ;
- cauldron;
- pump;
- boiler.

The conditions which has to respect for the working order of the equipment are the next:

- the used liquid is: water /antifreeze – which has to prevent the equipment freeze during the winter;
- the massic caloric capacity at the constant pressure: $c_p = 3,73$ [kJ/(kg·K)];
- the flow rate: about 140 [l/h];
- the ambient temperature: between 5 and 50 [°C];
- the intensity of the sun radiation: between 760 and 880 [W/m²].

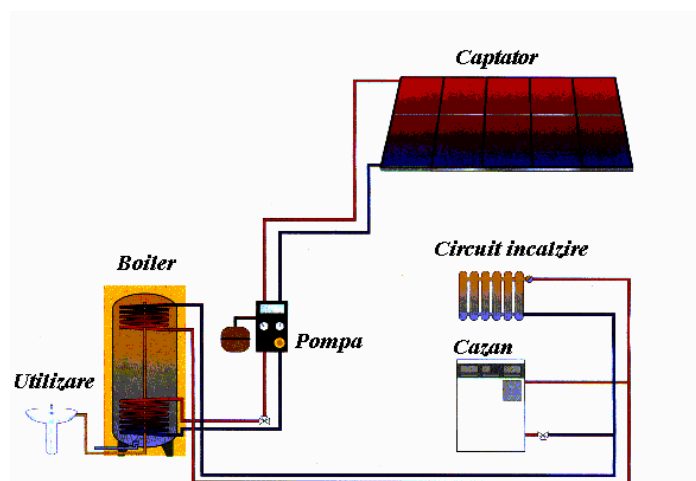


Fig.1.1. The diagram of the thermo-sun equipment

The thermo-sun radiation heats up the absorber of the sun collector, the heat being send afterwards by means of the heat carrier towards the water from the sun tank (boiler).

The warming thermal carrier gives its power the heat exchanger of the sun circuit placet in the bottom tank.

During the working, when the temperature from collector is bigger than the temperature from the underside of the tank, the heat diferential regulator activitates the circulating pump. According to the other control types, the pump can be adjusted its rotative speed.

Keeping constant the temperature diferences, the tank can be loaded uniform, thus is reduced the power demand and is kept an efficient rotative speed of the pump.

1.2. Main components

The main components from the equipment diagram are:

- Collector Solarterm – the sun collector made in Romania ;
- Collector Lb.Wagner- the sun collector made in Germany;
- Tank 1- Eco plus tank achieved by Wagner German Company;
- Tank 2- Wagner tank achieved by the same Wagner German Company;
- Circo 4 – the equipment of the sun circuit;
- Pc- the circulating pump ;
- Sp – the pressure valve;
- d – dose for the damage prevention of the sun regulator due to the lightning discharges;
- D – flow-meter with float;
- Ap – water-meter ;
- S – valves;
- R – valves;
- Pt 100– temperature transducers;
- SunGo X1 – sun regulator;
- Wmz – data acquisition plate;
- Rs 232 – serial interface for the data transmission towards the computer,
- PC – the computer on which does the monitoring.

1.2.1. Sun collector

The sun collector is the essential element of an equipment which change the sun power radiant in another power form. The main sides of the sun collector are:

- The absorbing black surface of the sun radiation, which has the transfer resources of the absorbed power towards a fluid whis is heat carrier;

- One or many transparent surfaces for the sun radiation (glasses), fixed above the absorbing surface, which are necessary for reducing the heat losses by conduction;

- Housing

This has the next advantages:

- Uses as the direct sun radiation as the difusse radiation;
- Sun collector doesn't involve a precise orientation after sun;
- Have a simplier construction;
- Involve a easier service.

The application field of these collectors is that the moderate temperatures of 100°C order over the ambient temperature.

1.2.2. Collectors

It uses two collectors types: LB-WAGNER Sun Collector and SOLARTERM Sun Collector. Two other types of sun thermal collectors, SOLARTERM and WAGNER, have been integrated in the roof of a link buliding which is necessary for the access between Sun Amphitheatre and Electrical Engineering Faculty.

The thermosun equipment is composed by two equipments: the Romanian equipment and the German equipment which are identically. Thus, a lot of components from the block diagram are the same. German Sun Collector, LB-WAGNER is used generally in the case of the big sun equipments. Having a catching surfaces of 5m² and a casing-off of the catching surfaces, the Gernman collector has a fast mounting system. LB-WAGNER collector has the next elements:

- sun glass – 4mm thickness ;
- black plate with the selective layer;
- mineral wool - 30 mm grosime;
- thermoinsulating fibre board- 30mm thickness.

All ensemble of the German collector leans on a frame which is fabricatced by the aluminium profiles.

SOLARTERM sun collector has the next characteristics which are presented in Table 1.2

Table 1.2.

Dimensions	3400 x 2100 x 110 mm
Collecting surface	7,4 m ²
Performances	$\eta_0 = 65 \%$ $k = 4,5 \text{ W/ m}^2\text{K}$ Capacitatea de căldură = 1588 kJ/m ² h
Polycarbonate	Thickness = 10 mm, double layer Transmission Factor , $\tau = 80 \%$
Thermoinsulating	50 mm
Black plate	Chrome – Nickel, selective layer: absorption $\alpha = 96 \%$ emission $\varepsilon = 40 \%$, la 0°C
Capacity	33 litres
Pressure	2,5 bar
Stoppage Temperature	140°C
Heat Carrier	DC 20 – propilen glicol with inhibitors

1.2.3. The pump unit

In Table 1.3 are given the technical characteristics of the pump unit.

Table 1.3

Thermal conductivity of the insulating layer (two layers), EPP	$\lambda = 0,030 \text{ W/(m} \cdot \text{K)}$
Working High Pressure	6 bar
Working High Temperature	120°C
Incoming power (W)	3 – steps 44/62/81
Circulating Pump (230 V, 50Hz)	Tip 25/6
The height of the lift pump	560 bar
Flow rate	0,5 m ³ /h
Connector- expansion vessel	3/4" (exterior)
Connector- purging pipe	3/4" (interior)
Connector-sun circuit	φ 18 –22 mm
Dimensions	490 x 250 x 170 mm
Weight	7,2 kg

2. THE DATA ACQUISITION AND THE RESULTS INTERPRETATION

2.1. The correlation study between the sun radiation and the stored power in boiler

It can observe the evolution of the collector temperature dependent on time (red colour). In the hour interval 8 a.m. and 10 p.m. is a gradual increment of the collector temperature (due to the increment of the sun radiation). At 10 a.m. is a fast increment (between 30 and 44 °C). This temperature conducts to the starting of the pump which begins to re-circulate the calorific liquid in the ensemble collector-boiler. In the same time with this process happens a fast process of the stored power (mauve colour). The water temperature from the heat exchanger increases gradually in the interval 29-42 °C (the light red colour) in the period 10 a.m.-1 p.m. In the presented diagram, we can observe the dependence between the collector temperature and the stored power in the boiler (Fig.2.1)

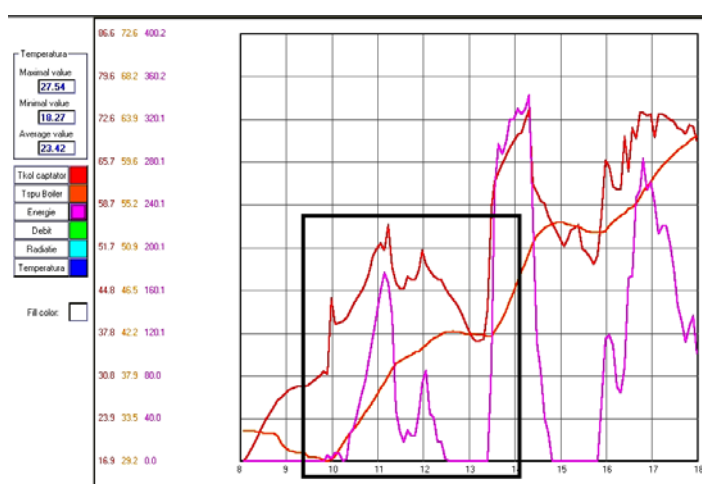


Fig 2.1. The temperature of the collector in terms of time

2.2. The correlation study among the stored power, the external temperature and the sun radiation

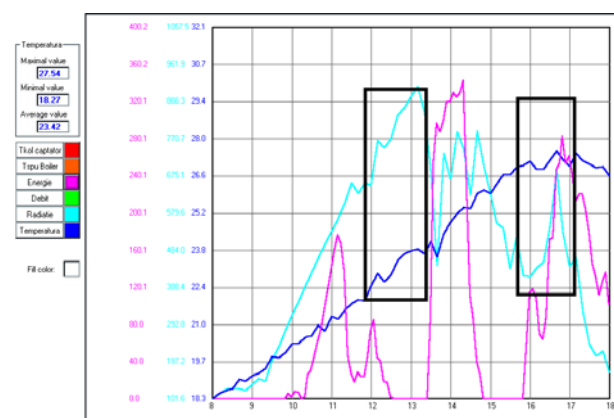


Fig. 2.2. The temperature of the collector in terms of time

From this diagram we can observe that the sun power doesn't dependent on the environment temperature. The external temperature is shown on the diagram with blue colour, the sun radiation with light green and the stored power with mauve.

In the interval 12 p.m.-1 p.m. the ambient temperature has been between 22.4-23.8 °C and the sun radiation has been between 675 and 866 W/m².

In the interval 3 p.m.- 4 p.m. the temperature has been between 26-28 °C, and the sun radiation has been between 580 and 420 W/m². The sistem optimization will do only regarding to the parameters of the sun radiation (indirect) and by no means of the environmental temperature. It can find the increase of the stored power by means of the data aquisition which monitorizes: the external temperature, the collector temperature, the wind velocity, the atmospheric pressure and the relative humidity of the air, integrating with the stored parameters in memory.

2.3. The correlation study among the storage power, the sun radiation, and the operating conditions of the pump

In the interval 10 a.m.-12.30 p.m. the pump has worked with a flow of 6 l/min, obtaining a storage of a power of 2 kWh. In the interval 11.30 a.m.-12 p.m. the pump has worked with a flow having 3 l/min, obtaining a storage of a power of 0.4 kWh.

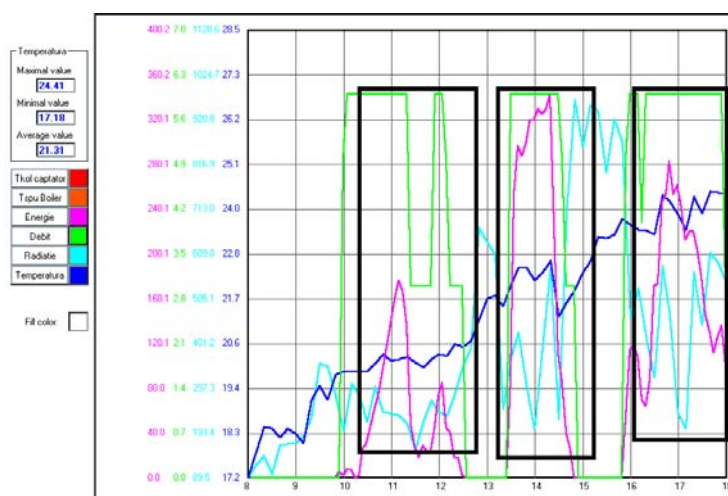


Fig.3.2. The direct connection between the storage power (violet) and the operating speed of the pump (green)

It is very clear the connection between two monitorised elements: the stored power and the pump speed. The pump outset is achieved by means of the integration of the temperature difference between collector and boiler with PID of the regulator.

The input of pump is very important in the establishment of the global efficiency of the equipment. Depending on the temperature error between collector and boiler is commanded the pump service sequential: 25, 50, 75, 100 %.

3. CONCLUSIONS

The essential conclusion is that the visualization and the explanation of the operating diagrams give us a better optimisation for the operation of the thermosun equipments.

REFERENCES

1. Dănescu A., Bucurenciu, S., Petrescu, S., *Usage of the sun power*, Technic Publishing House, Bucharest 1980.
2. *Instructions of design for the sun equipments Viessman and Wagner&Co*
3. *Installations Book*, Artecno Publishing House, Bucharest, 2003
4. *The research contracts*, Power-Environment Department, "Valahia" University of Targoviste
5. Olariu N., Măntescu G., Cobianu, C., Popa, M., *Informations regarding the buildings integration of thermo-sun collectors*, International Symposium on Electrical Engineering, 3-4 June, 2002, Târgoviște, pg.46-56