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EXPERIMENTAL RESEARCH ON THE INFLUENCE OF SOLAR RADIATION ON SOLAR COLLECTORS WITH VACUUM TUBES

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Abstract: *This paper addresses the problem of reducing the energy consumption of conventional sources, due to the use of solar energy. The hotel complexes in isolated mountain areas leverages solar energy using vacuum tubes collectors and solar collectors consequential for domestic hot water. Requirements panels and solar collectors is dependent on the capacity of the hotel complex and the services offered to tourists. It notes the importance of the hotel complex orientation to the sun and the seasons with maximum requests for its services.*
Keywords: *Vacuum tube collector, installation with solar collectors, solar energy*

1. INTRODUCTION

Resorts up in isolated mountain areas are increasingly sought after by tourists from Romania for indicative of the conditions in which they are located: quiet, clean natural environment, the opportunity for winter sports and hiking trails etc. Also, the resorts is designed for carrying out scientific or business promotion.
Comfort requirements imposed on such units is spread over a wider range, starting with the specific minimum cottages and ending with 5 star hotels, the services are complex and at the highest level.
The increasing use of renewable energy is favorable preserve the environment (sustainable development), but also to achieve energy independence of these business units
Experimental data on the characteristics of solar energy coming from the mountains in Brasov County. Also considered solar technical equipment to be used in a hotel unit of this type are the next generation in terms of efficiency and reliability

2. TECHNICAL REQUIREMENTS

Solar potential in Romania is represented by average energy density of incident solar radiation, horizontally exceeding 1000 kWh/m2/year
In Romania have identified several geographic areas with differentiated level of energy flow recorded, and the regime of geographical distribution, solar energy potential shows that more than half of Romania's area benefits from a flow annual average of 1000 kWh / m2 / year

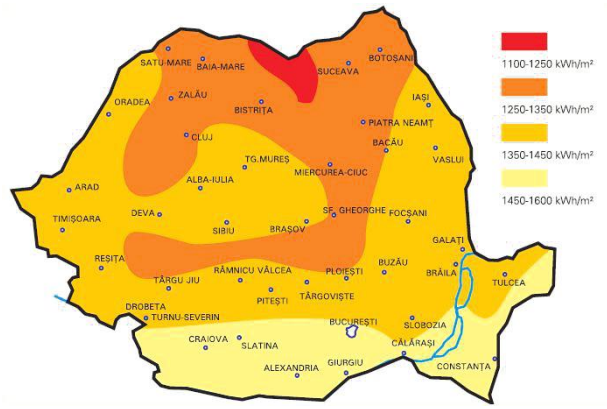

Figure.1 *shows the map of solar radiation in Romania* [1]

Using solar energy for hot water supply has proved to be a perfectly viable solution. The operating principle of heating water system with solar energy is simple and the technology is already well known and reliable.
Solar energy is clean, inexhaustible, clean and safe. This facilitates saving energy resources, without producing waste or emit polluting gases, such as carbon dioxide. Above pollution problems and the impact of greenhouse gases, hot water supply represents a considerable part of the energy bill of buildings, which can be reduced by using solar energy. Solar energy can be used in order to meet energy needs in isolated geographic areas or with limited access to power grid.

Collecting solar energy:

Direct capture of solar energy involves artificial means, called solar collectors, which are designed to capture the energy, focus sometimes by direct sunlight.
Energy once captured is used in thermal processes, photoelectric or photovoltaic. In thermal processes, solar energy is used to heat a gas or a liquid, which is then stored or distributed. The photovoltaic solar energy is converted directly into electricity without the use of mechanical devices intermediate.
Solar collector is the essential element of a solar plant that converts radiant energy into another form, useful energy. Solar collector works by heating a liquid (usually water, oil, air or glicoolul) which then releases the heat thermal system.

Flat solar collectors

Solar collectors have top flat sheet of glass high transmissivity and the inner side of aluminum foil, with a very good insulation (vacuum). Inside the panel there copper pipe through which a heat carrier glycol. Collectors are flat, the surface area of solar collectors that absorb a certain amount of solar radiation is the same as the surface area that intercepts the amount of solar radiation.
They have the following main advantages:
- Uses both direct sunlight and diffuse;
- Have a simple construction;
- Involves easy maintenance.

The field of application of these probes is at the moderate temperatures of the order of 100 ° C above the ambient temperature.
After absorbing the surface, radiation sensors without concentration may be planar, cylindrical, semicircular, etc. In most cases, the absorbent surface is flat (or nearly flat) and respective collectors are called simply "flat collectors".
In the figure below are some variants of installation of pipes on the flat surface absorbing.

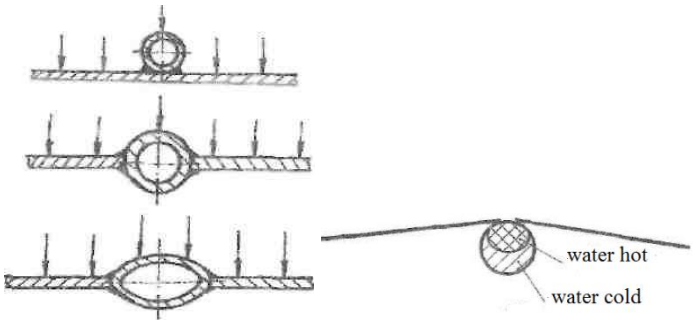

Figure 2. Types of pipe on flat surface absorbent collector

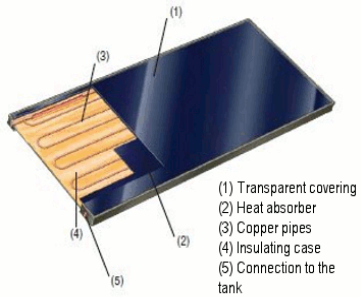

Figure 3. The components of a solar collector flat [4]

The frequently used flat collector panels include a housing isolated with a transparent covering of the solar radiation absorber. The absorber is generally a sheeting of dark copper, with a special coating, which absorbs heat and transmits it to a heat transfer fluid. The heated fluid is transported towards the tank by pipes.

The cost of manufacture of the flat collectors is relatively low, but they suffer from more heat loss than vacuum collectors. In comparison with vacuum collectors, the same power consumption requires a larger surface of collectors.

Vacuum tube solar collectors

This type of solar collector is used in complex solar systems for domestic hot water all year round and for additional contribution from domestic-heating

Vacuum tube is composed of conductive tubes operates on thermal (evaporative condensing)

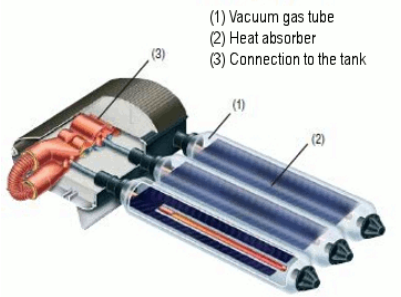

Figure. 4. Schematic of a vacuum tube collector [5]

These collectors are made of borosilicate glass tubing with a thickness of 1.6 mm, which provides high mechanical strength (hail), and the absorbent is made of the "black nickel", which provides an absorption coefficient a = 92 e-emission% and 8%, with a good a / e = 11.5.

Inside the tubes is evacuated (5.10 "3Pa) and heat transfer medium can reach out of the panel, temperatures max 210 ° C, which provides power 1000 W / m2, being from this point of view some of the best solar collectors plane, but their cost price is three times higher than conventional solar collectors, which provides power between 450 ... 550 W / m2. The return on these types of collector is so high due to the use very effectively to diffuse radiation of the sun and unnecessary collector orientation depending on the angle of incidence of the rays.

Solar radiation captured by solar collectors depends on their surface, such as the surface of solar collectors is higher the amount of energy captured and grow.

In figure 5 shows the distribution of solar radiation on the surfaces of the two types of solar collectors, vacuum tube solar collectors that flat plane

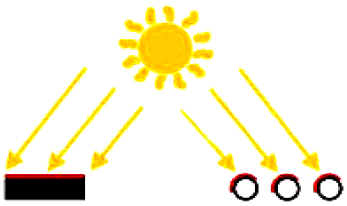

Figure. 4. Distribution of solar radiation flat plate collectors and vacuum tube collectors

In the above figure can be seen the difference between the surfaces of the two types of solar collectors, vacuum tube solar collector thus have an area greater absorption of solar radiation than flat solar collectors.

The location solar collectors

When installing solar collectors will consider compliance with principles such as: solar collector will always be oriented on south. The title must be as short possible. If necessary, a subtitle is provided.

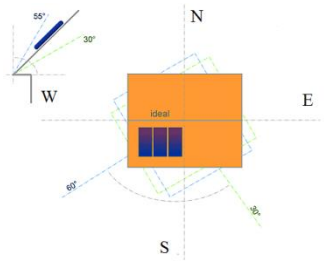

Figure. 5. The orientation of solar collectors

The angle of inclination of the collector from the horizontal is chosen according to:

- Geographic latitude of the locality;
- The conditions of the environment (pollution degree, the degree of shading plantations and construction, etc.).
- Solar collector can be mounted on the roof or on a metal frame type for the roof terraces.

Determination of surface collecting solar energy unit hotel.

The surface of solar power (S_p)

$$S_p = \frac{Q_z}{q_r \cdot \eta \cdot \eta_s} \qquad (1)$$

$$S_P = \frac{140000}{6000 \cdot 0{,}5 \cdot 0{,}8} = 58{,}3m^2$$

$$Q_z = N_p \cdot q_p \cdot (t_e - t_i) \qquad (2)$$

$$Q_z = 50 \cdot 70 \cdot (50 - 10) = 140000kcal / zi$$

$Q_z -$ daily flow of heat

$N_p -$ the number of people who prepare hot water, $N_p -$ 50 people

$t_e -$ hot water temperature at out of the installation; $t_e = 50^0 C.$

$t_i -$ cold water temperature before entering the unit; $t_i = 10^0 C.$

$q_r -$ daily solar radiation density;

$q_r = 6000Kcal / zi \cdot m^2$

$\eta -$ plant efficiency; $\eta = 0{,}5$

$\eta_s -$ battery thermal transmission efficiency. $\eta_s = 0{,}8$

3. CONCLUSION

To cover the hot water needs per unit of hotel with a capacity of 50 people are required 30 solar collectors, a solar collector area is 2 square meters

Solar energy is an inexhaustible source of energy, so using specific technology can achieve remarkable results for the supply of heating domestic hot water to the hotels in the mountain areas. Geographic data of our country are favorable for the use of solar energy.

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