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Renewable Energy and Rural Development**

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PERFORMANCE ANALYSIS OF A HYBRID WATER AND AIR SOLAR COLLECTOR WITH RECTANGULAR FINS

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Abstract: In this presented paper a hybrid solar collector with two fluids (water and air) is investigated. The studied configuration consists of rectangular fins in the lower air channel that are arranged perpendicular to the direction of air flow to enhance the heat transfer rate and efficiency. The effect of solar irradiation, ambient temperature, air and water inlet temperatures on the useful energy and thermal efficiency were studied. The indicated results show that the maximum efficiency obtained by using 10 rectangular fins at a constant mass flow rate of 0.1 kg/s was 65.8 %.

Keywords: hybrid solar collector, rectangular fins, solar water heater; solar air heater.

1. INTRODUCTION

Among the solar thermal technology, collectors have been widely used for water or air heating. There are many studies reporting solar water heating or solar air heating efficiency improvement methods. The solar water heater has been used in domestic purposes, and various types of solar water heater system were studied, such as flat plate collectors [1], concentrating collectors [2], evacuated tube collectors [3] and integrated collector storage system [4]. Also, researches have been made on the efficiency and water outlet temperature of solar collectors when integrated in thermosyphon systems [5]. The solar air heaters are used for applications at low and moderate temperatures. Several solutions have been proposed in order to improve the heat transfer efficiency of air collectors, like the development of various types of baffles [6], or modifying the dual- function solar collector by adjusting the interior air gap and changing the shape of the absorber [7].

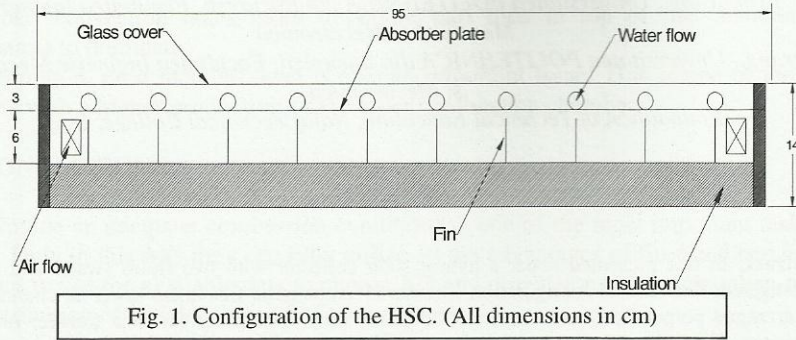
In the present work we perform the analysis of a hybrid solar collector (HSC) for water and air heating with rectangular fins in the air channel.

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2. MATHEMATICAL MODEL OF HSC

2.1 Description of the collector

Detailed description of HSC design and construction details are presented in figure 1. The absorber plate covers the full aperture area of the collector, absorbs incident solar irradiance and conducts the heat to water through 10 copper tubes welded at the top, and to the air that flows through the bottom side. To enhance the heat transfer to the air, galvanized fin located below, inside the 6 cm high air channel, and the amount of heat lost back to the surroundings is reduced to minimum. The collector tilt from the horizontal is 35°.



2.2. Theoretic modeling of the HSC

The essential components of the HSC for water and air heating are the glass cover, the back plate and the absorber. The performance of the HSC has been tested theoretically in the real operating conditions of Timisoara, Romania. (45° 44' 57" N / 21° 13' 38" E).

The performance of a hybrid flat-plate solar collector for water and air can be described by the useful heat gain from the collector, given as [8]:

$$q_{u,f} = F_{R,f} A_p S - U_{L,f} A_p (T_{f,in} - T_{amb}) \quad (1)$$

where: A_p is the collector gross area (m²), S is incident solar flux absorbed by the absorber plate (W/m²), $U_{L,f}$ is the overall loss coefficient for fluid (water or air) (W/m² K), $T_{f,in}$ is inlet fluid temperature (K), T_{amb} ambient temperature (K) and $F_{R,f}$ is collector heat removal factor for fluid (water or air) [9]:

$$F_{R,f} = \frac{\varepsilon_f \dot{m}_f C_{p,f}}{U_{L,f} A_p + \varepsilon_f \dot{m}_f C_{p,f}} \quad (2)$$

where: ε_f is heat exchange effectiveness of fluid (water or air) and $C_{p,f}$ is specific heat (J/kg.K). The heat transfer coefficient between water and the tubes is calculated from the Nusselt number:

$$h_f = \frac{k_f}{d} Nu_f \quad (3)$$

The heat transfer coefficient in the air channel with rectangular fins is calculated with the following formula [10]:

$$h_f = \frac{k_f}{d} Nu_a = 0.023 Re_a^{0.8} Pr^{0.4} \quad (4)$$

The thermal efficiency, which is defined as the ratio of the useful energy to the total incident solar radiation is expressed by the Hottel-Whillier-Bliss equation [8].

$$\eta = \frac{q_{u,f}}{A_p I_T} \quad (5)$$

3. RESULTS AND DISCUSSIONS

The daily solar irradiation and ambient air temperature during one day in Timisoara, Romania (45° 44' 57" N / 21° 13' 38" E) are presented in Fig. 2. The maximum solar irradiation and the maximum ambient temperature were 884 W/m² and 31 °C, respectively. The daily average ambient air speed was 0.54 m/s, ranging from 0.29 to 1.5 m/s.

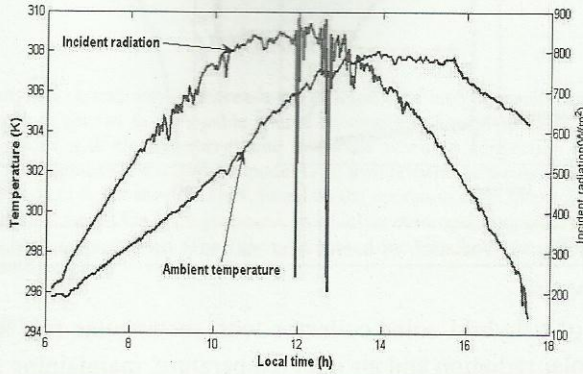


Fig.2. Variation of ambient air temperature and solar radiation intensity on 01/July/2010.

The mathematical algorithm presented above was implemented and solved in MATLAB. The variation of water outlet, air outlet and plate mean temperatures, respectively, are shown in Fig. 3. The maximum water and the air outlet temperature were 48 °C and 34 °C, respectively, results obtained for the water inlet temperature fixed at 40 °C.

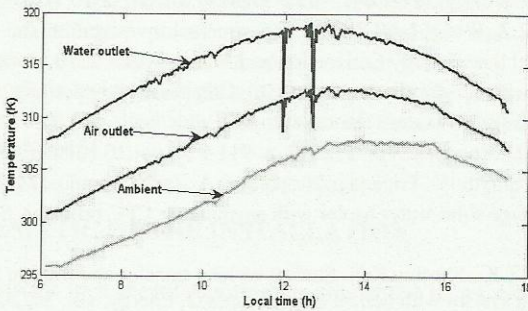


Fig.3. Variation of water outlet, air outlet and plate mean temperature

Figure. 4a shows the useful heat gain for water and air during the day as they were obtained from the computations. The average value of the useful heat gain for water is 534 W varying from 24 to 924 W, and the average value of the useful heat gain for air is 124 W, varying from 37.8 to 173.4 W.

The instantaneous efficiency of the HSC follows the same trend as the useful heat flux. It increases until noon time and then decreases as shown in Fig. 4b. The maximum efficiency value equals 65.8 % and occurs at 02:33.

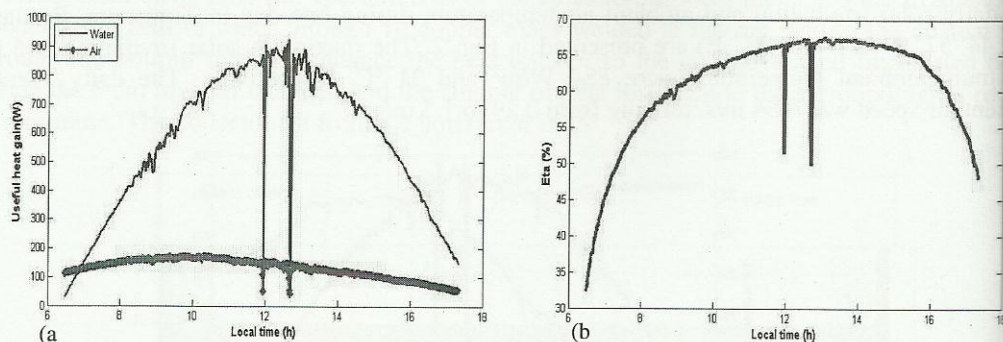


Fig. 4. Variation of useful heat gain and instantaneous efficiency with

4. CONCLUSION

The performance of a hybrid solar collector with rectangular fins has been simulated with a variable value of solar radiation and air inlet temperature, maintaining the water inlet temperature constant. The efficiency of the HSC with rectangular fins varied between 10 to 65.8 %, with an outlet temperature from about 307 to 319 K.

REFERENCES

- [1] E. Zambolin, D. Del Col. Experimental analysis of thermal performance of flat plate and evacuated tube solar collectors in stationary standard and daily conditions. *Solar Energy*, vol. 84, 2010, p. 1382–1396.
- [2] H. Zhai, Y.J. Dai, J.Y. Wu, R.Z. Wang, L.Y. Zhang. Experimental investigation and analysis on a concentrating solar collector using linear Fresnel lens. *Energy Conversion and Management*, 2010, p. 48–55.
- [3] Gang Pei, Guiqiang Li, Xi Zhou, Jie Ji, Yuehong Su. Comparative experimental analysis of the thermal performance of evacuated tube solar water heater systems with and without a mini-compound parabolic concentrating (cpc) reflector ($c < 1$). *Energies*. Vol. 5, 2012, p. 911–924; doi:10.3390/en5040911.
- [4] M. Souliotis, P. Quinlan, M. Smyth, Y. Tripanagnostopoulos, A. Zacharopoulos, M. Ramirez, P. Yianoulis. Heat retaining integrated collector storage solar water heater with asymmetric CPC reflector. *Solar Energy*. Vol. 85, 2011, p. 2474–2487.
- [5] Jaisankar, S., Radhakrishnan, T.K., Sheeba, K.N. Studies on heat transfer and friction factor characteristics of thermosyphon solar water heating system with helical twisted tapes. *J. Energy*, vol. 34, 2009, P. 1054–1064.
- [6] Ben Slama R., Bouabdallah M., Mora J. C. Air solar collector with baffles: Aerodynamics, heat transfer and efficiency. *RERIC International energy journal*, vol. 18, No.1, 1996.
- [7] Jinwei Ma, Wei Sun, Jie Ji, Yang Zhang, Aifeng Zhang, Wen Fan. Experimental and theoretical study of the efficiency of a dual-function solar collector. *Applied Thermal Engineering*, vol. 31, 2011, p. 1751–1756.
- [8] Duffie, J.A., Beckman, W.A. *Solar Engineering of Thermal Processes*, (Toronto, John Wiley 1991).
- [9] Assari, M.R., Basirat Tabrizi, Jafari, i., Experimental and theoretical investigation of dual purpose solar collector. *Solar Energy*, vol. 85, 2011, p. 601–608.