INCREASING THE EFFICIENCY OF SOLAR AIR HEATERS IN FREE CONVECTION CONDITIONS

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Abstract: *this article provides recommendations for improving the efficiency of solar air heaters in free convection and provides information on improving the efficiency of the device by installing solar and radiation surfaces of solar air heaters on it using special convective moving elements in the air.*
Keywords: *convection, heat exchange, air heater, efficiency, resistance.*

Solar energy is an attractive option for space heating and drying purposes as it can effectively conserve energy, is economically feasibl for long term usage, and is virtually maintenance free. Solar energy technologies greatly assist global efforts to combat excessive carbon dioxide and other greenhouse gas emissions by substituting the fossil energy with renewable energy resources. Energy gain determines the level of energy received by the solar absorber from the solar radiation and is essential for calculating collector efficiency. To increase energy gain by solar air collector, surface areas of the flat-plate have to be increase horizontally resulting in wider space requirements. Flat-plate design has a fixed angle which causes the collector performance to be susceptible to sun position and output air temperature fluctuates [1] based on weather condition, given that no active solar tracking function is implemented.

The thermal analysis for predicting the performance of different types of solar air collectors has been presented by many investigators. The mean difference between them lies in the estimated heat transfer coefficients and in the numerical solving procedures. In order to simplify the problem, numerous investigations have been carried out by considering that the plates are maintained at the main temperatures However, in solar air heaters, these temperatures vary along their length. Therefore, for accurate thermal simulations, we use a discrete approach which consists of dividing the collector into several differential elements in the air flow direction [2]. The solar energy system modeled in the present work is shown in Figs. (1) structure of the solar air heaters.

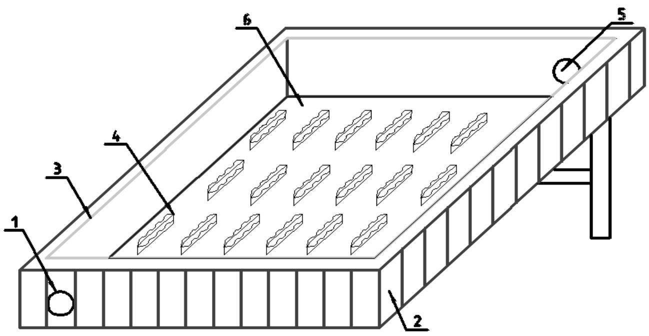

Fig. 1. Structure of the solar air heaters.
1- outlet of air, 2 - surface of device, 3 - glass, 4 - convection element, 5 - inlet of air, 6 - absorber

Solar air heater performance improves through the installation of a special convective carrier element on the flat part of the device. The air temperature rises to a high temperature as a result of the greater part of the air striking the convective actuating member.

The principal function of the convective heat transfer theory is to determine the amount of heat passing through the stream to behead. The ultimate heat flow will always be directed towards the temperature drop. Newton's law is used to calculate the heat transfer.

$$Q = \alpha F(t_c - t_\partial) \cdot \tau \qquad (1)$$

Q-amount of heat, α - heat transfer coefficient, F-surface t_c and t_d are the inlet and the outlet temperatures, τ-term

(1) In the formula $F = 1m^2$ and $\tau = 1$ seconds, we can calculate the density of the heat flow through a square meter surface.

$$q = \alpha(t_c - t_d) \qquad (2)$$

either

$$q = \frac{t_c - t_d}{1/\alpha} \qquad (3)$$

In contrast to the heat transfer coefficient, 1 / α is the thermal resistance of heat transfer. If we compare the equation (3) we will get the following:

$$\alpha = \frac{q}{tc - t_d} \qquad (4)$$

(4) accordingly, the heat transfer coefficient α is the heat transfer intensity, which is the difference between the surface temperature of the body surface and the average ambient temperature. The heat transfer coefficient α is equal to the thermal intensity of the heat at a temperature of 1°C [3].

Conclusion :

- to calculate the heat and energy efficiency of the solar air heater it is necessary to conduct experimental studies on heat transfer and aerodynamic resistance.

References

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