Thermal Performance Evaluation of Spiral Solar Air Heater

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Abstract- The depletion of fuel sources leads to energy crisis is serious and burning issue. The alternative energy is always better option and out of available resources like solar energy, wind energy and biomass; but compare to wind energy and bio mass solar energy is always better option because solar energy is the easiest source to extract useful energy in terms of availability in ample amount. The objective of present work is to develop spiral solar air heater and performance will be check using K type thermocouple.

Index Terms- Alternative energy, Solar Energy, Spiral Solar Air Heater

I. Introduction

Situation in energetic become more acute with every year. With increase of manufacturing, increases both need for heat as well as for electrical energy. It is well known that great amount of total consumed energy is produced in way of combustion of several fossil fuels: solid, liquid and gaseous. As known fossil fuels are expensive, require for a stockroom, combustion of them makes pollution of the atmosphere and resources of fossil fuels in the nearest future will run away. These are reasons why an alternative energy sources are becoming more and more charismatic. Latvia is not rich in natural energy sources - approximately 70 % of them have to be imported. Solution of this problem is focusing to an alternative energy sources. Like an alternative energy sources in Latvia it is possible to use: biomass, biogas, waterpower, wind energy, geothermal heat and solar radiation. Solar radiation for water heating widely worldwide is used. In A lot of constructions of solar devices worldwide are known and each one of them is efficient in some specific locations and weather conditions.

Solar energy can be used by three technological processes: chemical, electrical and thermal. Chemical process, through photosynthesis, maintains life on earth by producing food and converting CO_2 to O_2. Electrical process, using photovoltaic converters, provides power for spacecraft and is used in many terrestrial applications. Thermal process can be used to provide much of the thermal energy required for solar water heating and building heating. Another one form of converted solar radiation is mechanical energy as wind and water steams.

II. Solar Air Heater [1]

Air systems are indirect water heating systems that circulate air via ductwork through the collectors to an air-to-liquid heat exchanger. In the heat exchanger, heat is transferred to the potable water, which is also circulated through the heat exchanger and returned to the storage tank. The main advantage of the system is that air does not need to be protected from freezing or boiling, is non-corrosive, and is free. The disadvantages are that air handling equipment (ducts and fans) need more space than piping and pumps, air leaks are difficult to detect, and parasitic power consumption is generally higher than that of liquid systems.

Types of Solar Air Heaters

1. Classification According to Air Channel Flow Configuration
   - Single Flow Single Pass
   - Double Flow Single Pass
   - Single Flow Double Pass
   - Single Flow Recycled Double Pass
2. Classification According to Air Channel Design
   - Flat Plate
   - Extended Surface Assisted
   - Porous Media Assisted

TabishAlam, R.P.Saini, J.S.Saini [2] investigated the effect of different turbulators on heat and flow characteristics of air heater ducts winglet were used in air heaters and found suitable to create turbulence to increase the heat transfer rate; however, substantial increase in pressure drop has been observed. Therefore, the design of the vortex generator is found to be a very critical task which needs attention to minimize the pressure drop through ducts.

Anil SinghYadav, ManishKumarThapak [3] studied the effect of artificial roughness in the duct of solar air heater performance and concluded that is an effective technique to enhance the rate of heat transfer to fluid flow in the duct of a solar air heater.

Ebru Kavak Akpinar, Fatih Kocyig˘it [4] performed the experimental investigation on effect of different obstacles on thermal performance of solar air heater. In the present study, four solar air collectors were tested and a comparison was made among them on the basis of first and second law efficiencies. It was shown that the efficiency of the solar air collectors depended

significantly on the solar radiation, surface geometry of the collectors and extension of the air flow line.

A.A. El-Sebaii, H. Al-Snani [5] studied effect on performance of solar air heater by various coating on absorber plate. To improve the heater performance, effect of using absorber plates coated with various selective coating materials on the heater performance was also investigated. The best performance was achieved using nickel–tin as a selective coating material with a daily average of the instantaneous efficiency of 0.46.

Rene Tchinda [6] focused on thermal behavior of solar air heater with compound parabolic concentrator with mathematical model for computing thermal performance of solar air heater with cpc having a flat one sided absorber plate and in experimentation consider the effect of air mass flow rate, the wind speed and the collector length investigated.

The present work related to study of copper tube shape on the thermal performance of solar air heater.

III. Experimental Set up

In the present experimental setup following parts are used

1. ½ inch copper pipes with 20 gauge of sheet of 1 m length.
2. ½ inch spiral copper pipes with 20 gauge of sheet of 1.5' diameter approximately.
3. 2 mm thick MS sheet with 1m X 0.5 m X 0.05m as solar heater (Straight Tube).
4. 2 mm thick MS sheet with 0.35m X 0.5 m X 0.05m as solar heater (Spiral).
5. Plain glass with above mention size and 3 mm thick
6. K type thermocouple
7. Digital Temperature indicator
8. Variable Blower Speed

Fig 1 Spiral Solar Air Heater

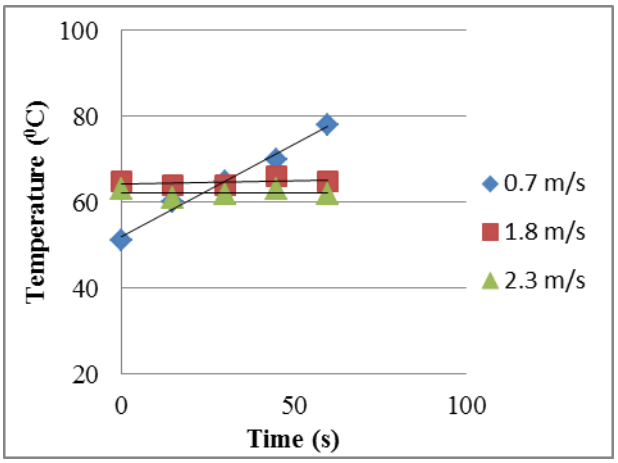
Fig 2 Spiral Coil

IV. Result and Discussion

Experimental Procedure

First of arrange the experimental set up in north south position and then connect the blower with set up using speed control electrical circuit and arrange three thermocouples out of two one at inlet and other at outlet and one on the body to measure temperature at different locations; set the blower at different speed using position of blower at position 4, 5 and 6.

Time (in)	**T1 (^{0}C)**	**T2 (^{0}C)**	**T3 (^{0}C)**
Low Velocity (0.7 m/s)			
0	42	76	51
15	42	80	60
30	42	90	65
45	42	90	70
60	42	92	78
Medium Velocity (1.8 m/s)			
0	44	90	65
15	44	87	64
30	44	86	64
45	44	88	66
60	44	86	65
High Velocity (2.3 m/s)			
0	43	82	63
15	43	83	61
30	43	84	62
45	43	83	63
60	43	84	62



At low velocity of air rice in temperature is high may be because of high retention period and more turbulent in the flow and as velocity increases the temperature rise reduces and rise in temperature in low range

V. Conclusion

The spiral solar air heater is compact and efficient and its performance is better at low velocity of air.

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