Experimental Study of Solar Air Heater Using of Aluminum Pipe

Sneha Mishra[1] Ishwar Singh[2]
[1]M Tech IV semester student,
[2] Assistant Professor.Department of mech. engg.
[1, 2] Scope college of Engineering, Bhopal (M.P.)

Abstract—*Solar air collector is a specific type of heat exchanger that transfers heat to air, which is obtained from absorbing solar radiation by absorber. In solar air collector heat transfer occurs from an energy source which spreads radiation to the air. It consists of an absorber plate, supportive walls, ducts or channels of fluid flow, glazing, air blower or fans (if forced convection), and insulation to minimize heat losses. Almost parts of solar air collector or heaters are thermally well insulated to reduce thermal heat losses. Glazing minimizes convective and radiative losses to the atmosphere and obtains solar radiation to stay between absorber and glazing, and to be absorbed by blackened absorber. Heat transferred to air by an air duct between glazing and absorber plate. SAHS are generally used to dry agricultural products, to dry fabrics and space heating*.

Key words: - speed regulator, Aluminum Pipe, Temperature

I. INTRODUCTION-

Solar air heaters are systems that collect solar energy and transfer the heat to passing air, which is either stored or used for space heating. The collectors are often black to absorb more of the sun's energy and a conductive material, often metal, acts as a heat exchanger. There are many different designs and systems may include fans to increase the flow rate of air. Alternatively, a passive collector can be built such that when the hot air rises it draws fresh air through the bottom. Fans can often increase the performance of the system, but require additional parts and adds complexity. Solar air heaters can compliment traditional indoor heating systems by providing a free and clean source of heat (after initial costs). While clouds effect the energy output of the system, the metal will store energy on a hot day and will reduce the impact of momentary cloud cover. To achieve best results, the system should be unshaded and facing the general direction of the sun (south for the northern hemisphere, north for the southern hemisphere).

II. OPTIMAL LOCATIONS AND ANGLES

- Meteonorm- Provides a visual reference to understand how much energy your geographic location receives from the sun.
- Solar Path Finder - Helps determine which angle the collector should be positioned, based on your location.
- Weatherbase - Has a large database of temperature and weather data that could be helpful in learning more about your heating and cooling demands.
- Report on Efficiency - An investigation into the efficiency of solar air heaters in cold climates.

III. DESIGN

Natural convection during a sunny day will allow the heater to pull cool air from your room, heat it and expel it back into the room as warm air. At night and on dark cloudy days the opposite is true. The heater will pull air from your room into the “heater” it will cool it and it will fall back into your room. A solar heater needs to include the ability to completely seal off airflow. To make this heater truly useable for people that are not at home 100% of the time, the heater needs to have the ability to open the sealed vent when the temperatures reach a higher temperature than the room, with no human interaction. The same should be done with heaters equipped with a fan. The fan needs to come on and shut off automatically. Until these issues are solved in an economic way solar heaters will not find wide spread use.

The above assertion is not true because if it were true that a reverse air current were generated when the room was hotter than the air inside the heater, the heat extracted from the air of the room during the reverse air flow would be maintained inside the heater only for a short time as it would eventually be emitted into the same environment outside the air heater. Such environment around the heater is, of course, inside the room where the heater is located.

To address the possibility of reverse air flow, first consider that the hot air would need to rise through the cooler air of the heater, yet if the air were cooled on its way up to be colder than that of the room, the air would not flow up.

To consider downward air flow, yes it is true that cold air settles when displaced by warmer air. The heater will not have cooler air because we assume the heater is completely inside the room and so there can be no "loss" of heat by the heater in relation to the room because if it gives up heat it will be giving it up to the room. If the heater were to share its plastic surface with an outside window, then there could be a current at night as the heat inside the heater is exchanged to the outside via the window acting as heat exchanger.

IV. EXPERIMENTAL SET UP

Two solar air heaters (s1 and s2) of same specific dimensions have been designed and fabricated to supply hot air for drying and space heating. Both air heaters were experimentally tested individually for their thermal performance on different configurations. The maximum amount of solar energy for s1. To reduce the heat losses, a 2 cm thick layer of glass-wool was placed between the absorber tray and outer cabinet. The single glazing has been considered especially for the maintenance of the SAHS. The efficiency effecting elements of the system like as halogen lights, inside wall of ducts for good reflection, and mainly the absorber tray are required to be very clean while performing (a float glass, beneath which the granular carbon is spread of heat storing for long hours) and for efficient working in good and poor ambient conditions.

Dusty transparent glass over storage media and dusty reflective walls will be resulted in lower efficiency of the system. Double glazing makes the system a little bit complicated in comparison of discussing system and more maintenance and attention will be required. The distance between glazing and absorber tray was 10 cm for both heaters.

This vessel was fabricated of an Al bucket with two ‘‘Ends’’ in which round shaped end was fixed with fans while rectangular end was fixed to the inlet duct of SAH. Other two ducts (inlet and outlet) of same dimensions were fitted to the SAH (fabricated with the same grade of Al) for air supply and for exhausting. Both ducts were also painted dull black.

V. Result and Discussion:

Table . 1 Airflow rate are 1.5m^3 / minute

Sr.No.	**Time**	**Temperature in Degree at inlet**	**Temperature in Degree at outlet**
1	**10:00**	**29**	**36**
2	**11:00**	**30**	**38**
3	**12:00**	**32**	**40**
4	**13:00**	**38**	**50**
5	**14:00**	**40**	**48**
6	**15:00**	**37**	**44**
7	**16:00**	**36**	**40**

Efficiency at time 10:00
Temperature at inlet =29 °C
Temperature at outlet =36°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (36-29)/29 =24.13%

Efficiency at time 11:00
Temperature at inlet =30 °C
Temperature at outlet =38°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (38-30)/30 =26.66%

Efficiency at time 12:00
Temperature at inlet =32 °C
Temperature at outlet =40°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (40-32)/32 =25.00%

Efficiency at time 13:00
Temperature at inlet =38 °C
Temperature at outlet =50°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (50-38)/38 =31.57%

Efficiency at time 14:00
Temperature at inlet =40 °C
Temperature at outlet =48°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (48-40)/40 =20%

Efficiency at time 15:00
Temperature at inlet =37 °C
Temperature at outlet =44°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (44-37)/37 =18.91%

Efficiency at time 16:00
Temperature at inlet =36 °C
Temperature at outlet =40°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (40-36)/36 =16.66%

Table . 2. Airflow rate are3 m^3 / minute

Sr.No.	Time	Temperature in Degree at inlet	Temperature in Degree at outlet
1	10:00	29	38
2	11:00	31	39
3	12:00	34	44
4	13:00	39	53
5	14:00	38	49
6	15:00	37	46
7	16:00	35	43

Efficiency at time 10:00
Temperature at inlet =29 °C
Temperature at outlet =38°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (38-29)/29 =31.03%

Efficiency at time 11:00
Temperature at inlet =31 °C
Temperature at outlet =39°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (31-39)/31 =25.80%

Efficiency at time 12:00
Temperature at inlet =34 °C
Temperature at outlet =44°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (44-34)/34 =29.41%

Efficiency at time 13:00
Temperature at inlet =39 °C
Temperature at outlet =53°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (53-39)/39 =35.89%

Efficiency at time 14:00
Temperature at inlet =38 °C
Temperature at outlet =49°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (49-38)/38 =28.94%

Efficiency at time 15:00
Temperature at inlet =37 °C
Temperature at outlet =46°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (46-37)/37 =24.32%

Efficiency at time 16:00
Temperature at inlet =35 °C
Temperature at outlet =43°C
ή= (Temperature at outlet -Temperature at inlet) / Temperature at inlet
= (43-35)/35 =22.85%

VI. CONCLUSION

heat transfer between the absorber plate and the air stream reduces sensibly the temperature of the absorber and in same time the heat losses are reduced. Collector the double glazing gives lower thermal performance than the triple glazing this is due to the heat losses towards the surroundings..The air stream reduces sensibly the temperature of the absorber and in same time the heat losses are reduced. With the offset fin collector the double glazing gives lower thermal performance than the triple glazing this is due to the heat losses towards the surroundings.

REFERENCE

[1] A.S. Nafey, etal. Solar desalination using humidification- dehumidification processes. Part I. A numerical investigation. Energy Conversion and Management, 45 (2004) pp.1243–1261.
[2] A.A. Mohamad, etal. High efficiency solar air heater. Solar Energy, 60 (1997) pp. 71–76.
[3] A. Ghoneyemetal.Software to analyze solar stills and an experimental study on theeffects of the cover. Desalination, 114 (1997) pp.37–44.
[4] A. Hachemi etal. Experimental study of thermal performance of offset rectangular plate fin absorber plates Renewable Energy 17(1999)pp.371-384
[5] .A. Georgiev etal. Testing solar collectors as an energy source for a heat pump Renewable Energy 33 (2008) pp.832–838
[6] Bessler WF etal. Solar assisted heat pumps for residential use. ASHRAE J 1980; pp.59–63.
[7] CemilYamal etal.Theoretical investigation of a humidification dehumidification desalination system configured by a double-pass flat plate solar air heater Desalination 205 (2007) pp.163–177
[8] Chaturvedy SK etal. Energy conservation potential of large capacity Solar-assisted heat pumps for low temperature IPH applications. Trans ASME, J Sol Energy Eng 1985 pp.286–296.
[9] Cottingham JG.etal. Heat pump design: Cost-effectiveness in the collection, storage and distribution of solar energy. ASHRAE J 1979 pp.35–38
[10] Chandrashekaretal. . A comparative study of solar assisted heat pump systems for Canadian locations. Solar Energy 1982; pp.217–226.
[11] D. Jain, etal. Modeling the system performance of multi-tray crop drying using an inclined multipass solar air heater with in-built thermal storage. J. Food Eng., 71(2005) pp.44–54.
[12] E. Chafik, etal. A new seawater desalination process using solar energy. Desalination, 153 (2002) pp.25–37
[13] Freeman TL etal. Performance of combined solar–heat pump systems. Solar Energy 1979 pp.125–135.