Thermal Performance Evaluation of Evacuated Tube Solar Water heater with and without Twisted Tape

Vikas Keen[1], Swati Prajapati[2]

[1] *P.G. Student, Thermal Engineering, Parul Institute of Engineering & Technology, Gujarat, India*
[2] *Assistant Professor, Thermal Engineering, Parul Institute of Engineering & Technology, Gujarat, India*

ABSTRACT

The sun is the source of all energy. The solar energy can be used for heating and cooking purpose. The utilization of solar energy for heating of water is common application but efficient water heating is the toughest because it depends on whether condition and to overcome such difficulty various modifications have been proposed by different researcher in terms of modification in pipe shape or in terms of change in the material of absorber plate etc. and so the objective of present work is to evaluate thermal performance of Evacuated Tube solar water heater with and without insertion of twisted tape.

Keyword- *solar energy, Evacuated Tube, twisted tape etc….*

1.INTRODUCTION.

The energy availability plays a vital role in economic activity because production and manufacturing can be fulfilled by energy consumption only. Nowadays low cost energy is necessary for economical development of any country but because still the major energy extraction is possible using fossil fuels and those countries which have not sufficient amount of such fossil fuel facing lot many issues related unemployment; but the solution of this energy crisis is available from alternative energy sources like solar energy, wind energy and bio mass and bio fuel etc. Solar energy is responsible for all of the light and most of the heat we experience on Earth. That's a lot of free energy floating around. The sun's heat can be harnessed with absorption and conduction in solar thermal collectors to heat water. It can be concentrated with mirrors to cook food and applied to rooms in need of heating with some well-placed windows. Photons (light) from the sun can even be converted into electricity through photovoltaic cells. Raj Y. Taheri, Behrooz M.Ziapour,K.Alimardani [1] investigated a new techniques for solar water heater using black coated sand and all experiments results, the collector averaging daily efficiencies achieved higher than 70%. K.K. Chong, K.G. Chay, K.H. Chin studied [2] solar water heater using stationary V-trough collector. Integrating the solar absorber with the easily fabricated V-trough reflector can improve the performance of solar water heater system. In this paper, optical analysis, experimental study and cost analysis of the stationary V-trough solar water heater system are presented in details. Hussain Al-Madani [3] performed experiment on cylindrical solar water heater the efficiency of the cylindrical solar water heater was calculated. The maximum value during the experimental period was found to be 41.8%. This reveals a good capability of the system to convert solar energy to heat which can be used for heating water. An economic analysis has reveals that the cylindrical solar water heater compared with the flat plate collector is cost effective. S. Jaisankar, J. Ananth, S. Thulasi, S.T. Jayasuthakar, K.N. Sheeba [4] studied various techniques to enhance the thermal efficiency in solar water heater. In addition to this, a detailed discussion on the limitations of existing research, research gap and suggested possible modifications is made.

2. EXPERIMENTAL SET UP.

In the present work from glass material evacuated tube is fabricated having inner diameter of 47 mm and 58 mm with length of 1800 mm having storage tank of 50 lt capacity with 500 mm diameter and 580 mm length made of

GI coated material. Twisted tape made of copper strip 1 mm thick 1200 mm long with 180 mm pitch and 25 mm width. Two set up has been fabricated one with twisted tape insertion and one without twisted tape insertion.

Fig -1 Evacuated Tube

Fig. 2 Storage Tank

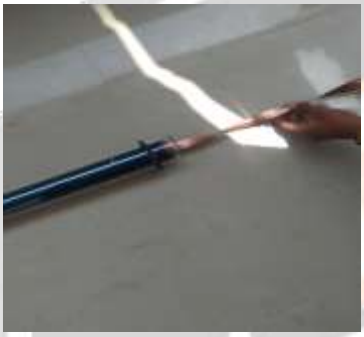

Fig. 3 Twisted Tape Inserted Inside the Tube

Fig 4 Twisted Tape Inside the Tube

Fig. 5 Twisted Tube and Evacuated Tube

Fig. 6 Experimental Set Up

3. RESULT AND DISCUSSION.

In this work both set up are placed on same day with same orientation to compare the results of solar water heaters with and without twisted tape.

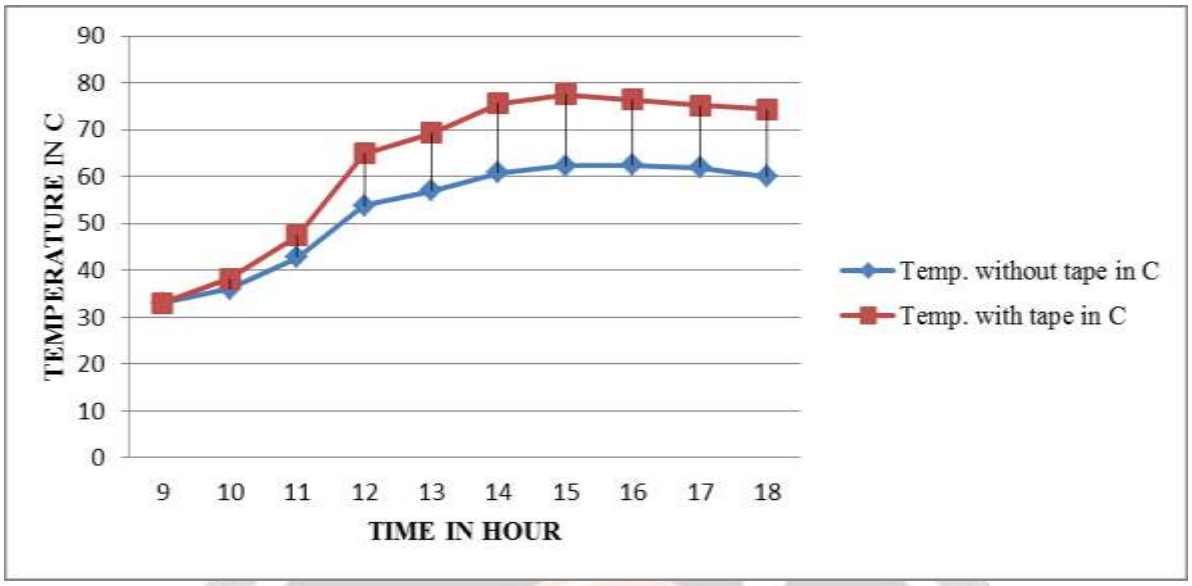

Chart -1: Temperature Variation w.r.t Time

Table 1 Temperature Variation and Heat Transfer

Time Hour	Outlet temp. without tape in ^{0}C	Heat transfer without tape in kJ	Outlet temp. with tape in ^{0}C	Heat transfer with tape in kJ	% Increment
9:00	33	0	33	0	0
10:00	36.1	21664.66	38.3	37039.58	70.96
11:00	42.8	68488.28	47.4	100635.84	46.93
12:00	53.8	145362.88	64.9	222936.34	53.36
13:00	57	167726.4	69.3	253686.18	51.25
14:00	60.8	194283.08	75.6	297714.36	53.23
15:00	62.3	204765.98	77.5	310992.7	51.87
16:00	62.5	206163.7	76.4	303305.24	47.12
17:00	61.9	201970.5	75.2	294918.92	46.02
18:00	60	188692.2	74.3	288629.18	52.96

In this work compare to solar water heater without twisted tape the rise in temperature is better in case of solar water heater with twisted tape due to more retention period and more rate of turbulence in the flow

4. CONCLUSIONS.

The major conclusions of present work is, There will be more heat collected through evacuated tube. The percentage increment in max. heat transfer is 50.84 in solar water heater with twisted tape as compare to without twisted tape.

Solar water heater must not lose the heat from water to air due to convection, because of there is evacuated tube in which vacuum is created in annular space .Due to introduction of twisted tape there will be more heat transfer because of water passing through swirling action.

5. REFERENCES.

[1] Y. Taheri, Behrooz M.Ziapour,K.Alimardani, Study of an efficient compact solar water heater, Energy Conversion and Management 70 (2013) 187–193

[2]. K.K. Chong, K.G. Chay, K.H. Chin, Study of a solar water heater using stationary V-trough collector, Renewable Energy 39 (2012) 207-215

[3]. Hussain Al-Madani, The performance of a cylindrical solar water heater, Renewable Energy 31 (2006) 1751–1763

[4]. S. Jaisankar, J. Ananth, S. Thulasic, S.T. Jayasuthakar, K.N. Sheeba, A comprehensive review on solar water heaters, Renewable and Sustainable Energy Reviews 15 (2011) 3045– 3050