2nd International Conference on Current Research Trends in Engineering and Technology
© 2018 IJSRSET | Volume 4 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Thermal Performance of Square tube Solar Water Heater

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ABSTRACT

A Square shaped tube with Spring insertion in Solar water heater. The fluid flow and heat transfer characteristics were carried out of a squared shaped tube with spring insertion. We are going to increase the performance of solar water heater by changing cross section area of its pipe. By using Square pipe instead of circular we get the more surface area with the same size. As the surface area increases , the heat transfer rate also increases which increase the performance of solar water heater. In addition to this, a close coiled helical spring is also inserted inside the each square tube of solar water heater. By which water will remain for more time in square tube compared to circular tube it will also helps to improve the performance of the same.

Keywords- Square tube, Circular tube, Helical spring, K type thermocouple, Water storage Tank 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 economic 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.

1.1 Solar Energy

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. As renewable energy sources go, the sun is by far the largest and most accessible here on Earth.

1.2 Solar Water heater

SWH systems are generally very simple as they are usually using only sunlight to heat water. The working fluid is brought into contact with a dark surface exposed to sunlight which in turn causes the temperature of the fluid to raise. This fluid might be water, that is being heated directly, is also known a direct system, or it may be a heat transfer fluid such as a glycol/water mixture that is passed through some form of heat exchanger called an indirect system.

1.3 Types of Solar Water Heating system

1.3.1 Active System

Active systems use electric pumps, valves, and controllers to circulate water or other heat-transfer fluids through the collectors. So, the Active systems are also called forced circulation systems and can be direct or indirect.

1.3.2 Passive System

Passive systems are simply circulating water or a heat transfer fluid by natural convection between a collector and an elevated storage tank (above the collector).

The principle is simple, as the fluid heats up which in turn decreases its density. Hence the fluid becomes lighter and rises to the top of the collector from where it is drawn to the storage tank. The fluid which has cooled down at the foot of the storage tank then flows back to the collector. Passive systems can be less expensive than active systems, but they can also be less efficient. Thermo-siphon system is the best example of passive systems.

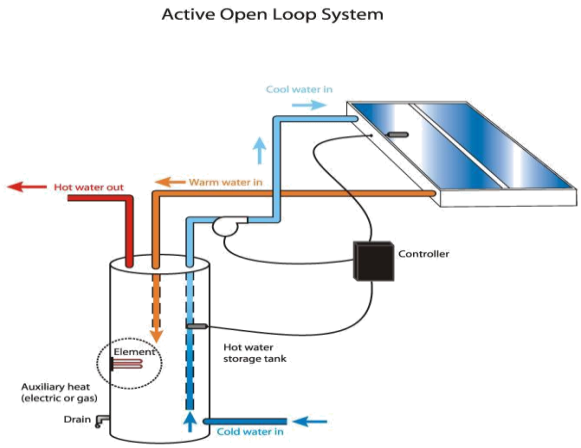

Figure 1: Active System

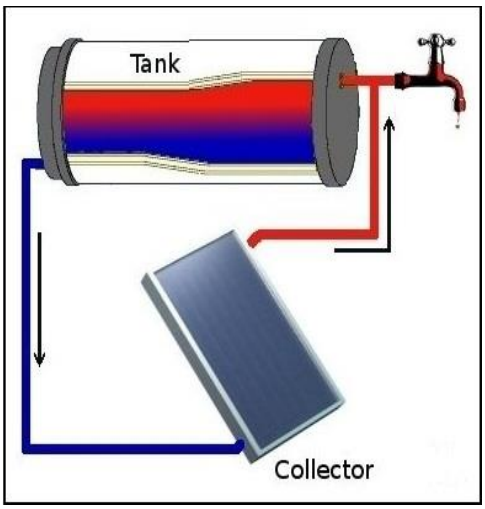

Figure 2: Passive system

2. METHODS AND MATERIAL

2.1 Process description:

The solar radiation passes through the glass in front of the absorber plate and strikes the flat black surface of the absorber plate where the solar energy is absorbed as heat (i.e., by increasing the internal energy). This causes the flat-plate collector to become very hot, and so the water contained in the risers and headers bounded to the plate also absorb the heat by conduction. The water inside the tubes (risers/headers) expands and so becomes less dense than the cold water from the storage cylinder. On the principle of thermosyphon, hot water is pushed through the collector and rises by natural convection to the hot water storage tank and cold water from the cold water tank simultaneously descends to the bottom header of the collector by gravity pull. Therefore, there is circulation as a result of an increase in temperature and volume of the warmer water to the hot water storage tank. The circulation continues as hot water goes out, while cold water comes in.

Components	**Parameter**	**Size**(mm)	**Material**
Wooden Box	All Dimensions	1000×500×100	Wood
Circular Pipe	Diameter	12.4	Copper
	Length	1000	
Square Pipe	Limb Height	12.4	Copper
	Length	1000	
Closed Coil helical Spring	Wire Diameter	1	MS
	length	1000	
Storage Tank	Capacity	20 liter	Standard
Transparent Glass	Thickness	3	Standard

2.2 Design parameters

2 M E T

Figure 3. Convectional SWH& Square tube SWH

Figure 4. Storage Tank

3. Observation table:

sr	Circular tube SWH			Square tube SWH		
	Mw(Kg/sec)	Temp In(°C)	Temp Out(°C)	Mw(kg/sec)	Temp In(°C)	Temp Out(°C)
1	0.0029	31	45	0.0031	31	47
2	0.0029	32	49	0.0031	32	53
3	0.0029	31	56	0.0031	31	58
4	0.0029	32	63	0.0031	32	66
5	0.0029	33	68	0.0031	33	74

RESULTS AND DISCUSSION

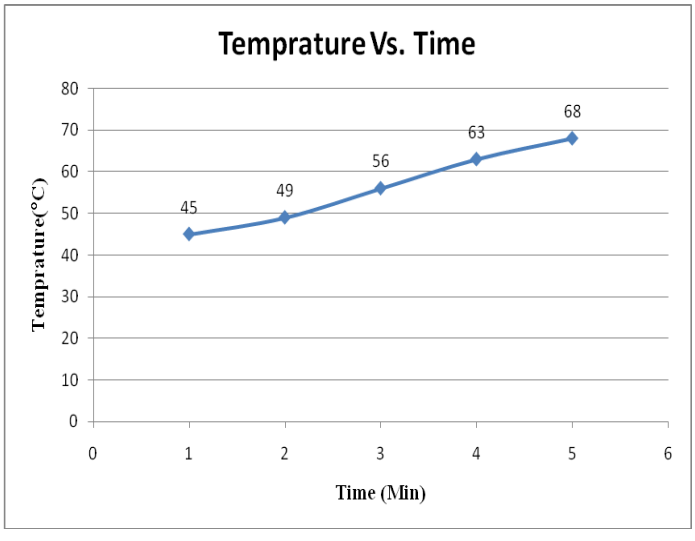

Figure 5. Circular tube SWH

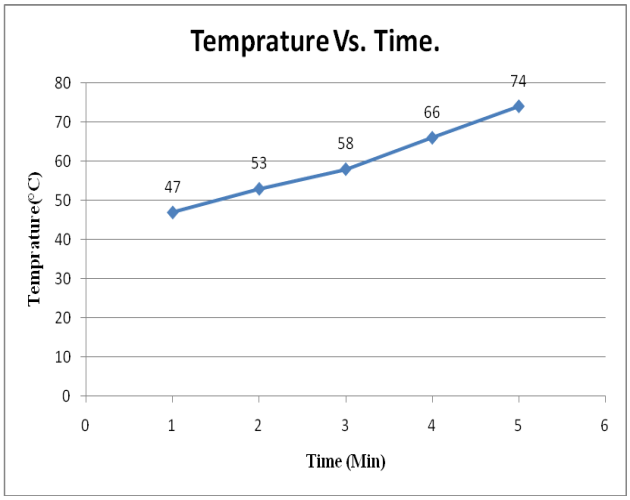

Figure 6. Square tube SWH

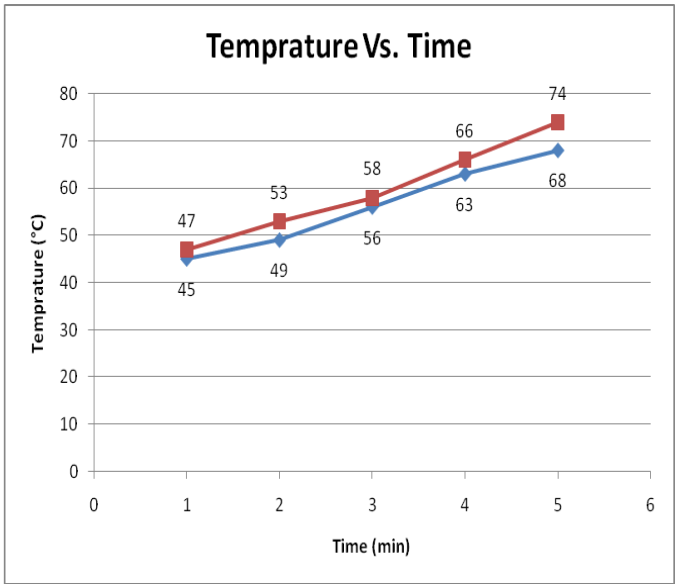

Figure 6. Comparision between Circular and Square tube SWH

For Heat Transfer is :-
Q = m × Cp × (Tout - Tin)

3.2 Result Table

Sr no.	Circular tube SWH		Square tube SWH	
	Mw(kg/Sec)	Qw(W)	Mw(kg/Sec)	Qw(W)
1	0.0029	3.4848	0.0031	3.7511
2	0.0029	3.5212	0.0031	3.8160
3	0.0029	3.6184	0.0031	3.8939
4	0.0029	3.6912	0.0031	3.9847
5	0.0029	3.7398	0.0031	4.0756

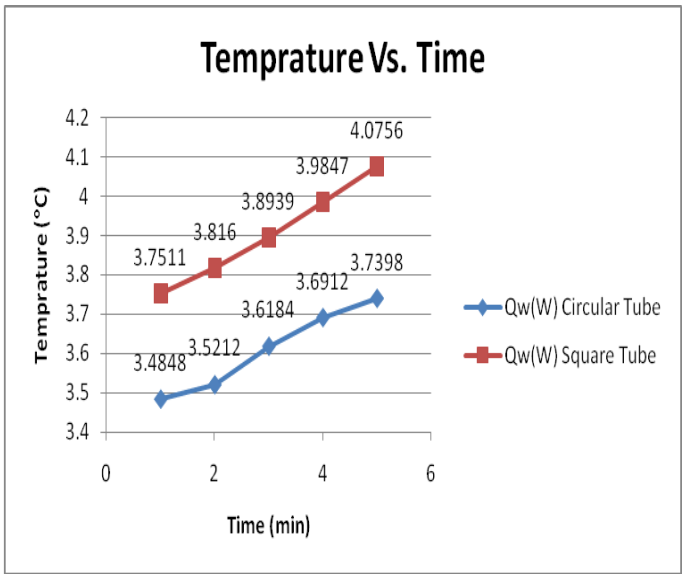

Figure 4. Result in Circular tube SWH and Square tube SWH

4 . Conclusion

A Square shaped tube with Spring insertion in Solar water heater. The fluid flow and heat transfer characteristics were carried out of a squared shaped tube with spring insertion. We are going to increase the performance of solar water heater by changing cross section area of its pipe. By using Square pipe instead of circular we get the more surface area with the same size. As the surface area increases , the heat transfer rate also increases which increase the performance of solar water heater. In addition to this, a close coiled helical spring is also inserted inside the each square tube of solar water heater. By which water will remain for more time in square tube compared to circular tube it will also helps to improve the performance of the same.The major conclusion from our system is to change only cross section rather then change in size.

5 . Refrences

1. Raj ThundilKaruppa R., Pavan P. and Reddy Rajeev D. Experimental Investigation of a New Solar Flat Plate Collector, Research Journal of Engineering Sciences Vol. 1(4), 1-8, October (2012)
2. MV. Kulkarni1, Dr. D. S Deshmukh, Improving Efficiency Of Solar Water Heater Using Phase Change Materials, International Journal Of Science, Spirituality, Business And Technology (IJSSBT), Vol. 3, No. 1, Dec 2014
3. R Sivakumar, V. Sivaramakrishnan, M. Vivekenandan, CFD Study of an Integrated Collector – Storage Type Flat Plate Solar Water Heater Without and with Fins, Dimples and V-grooves in Absorber Surface, International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS Vol:15
4. Eze J. I. and Ojike O. Analysis of thermal efficiency of a passive solar water heater, International Journal of Physical Sciences Vol. 7(22), pp. 2891-2896, 9 June, 2012
5. PSelvakumar, Dr.P.Somasundaram, Effect of Inclination Angle on Temperature Characteristics of Water in-Glass Evacuated Tubes of Domestic Solar Water Heater, International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 4, April 2012
6. FouedChabane, Nourddine Moummi2, Said Benramache Effect of the Tilt Angle of Natural Convection in A Solar Collector with Internal Longitudinal Fins, International Journal of Science and Engineering Investigations vol. 1, issue 7, August 2012