Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Design and Fabrication of Conical Shaped Solar Water Heater Equipped with Convex Lens

Varun Gowda P R[1] , Nithin P[2] , Siddhartha M A[3] and Prajeeth A Goutham[4]
Department of Mechanical Engineering,
MIT, Mysore

***Abstract*— Conventional energy solutions are necessary in developing countries as current hot water production methods are becoming hazardous to the environment, economic development and the overall health and wealth of the population. In this work a conical shaped solar energy absorber has been developed and the system efficiency is determined. Solar water heater has been designed in a conical shape in order to utilize maximum amount of solar energy available and convert it into heat energy for the purpose of heating the water. Low cost materials have been used in the construction of the solar water heater and the heating has been achieved without the usage of the solar panels or solar cells and mirrors which decreases the cost of the equipment, thereby making it economically feasible. The flow system for water heater has been placed in a spiral manner due to its configuration. Heating efficiency of water has been increased by placing sand in a conical basin which is in contact with the surface of the tubes. A glass covering has been provided over the surface of the tubes thereby decreasing the reflectivity of the sunlight and enhancing maximum absorption. Based on the above design considerations the solar water heater has been fabricated and tested. The system efficiency is found out to be 61%**

Keywords: Conical vessel, Covex lens, Copper tubes, Solar technologies, Solar water heater.

INTRODUCTION

The increasing demand and depleting fossil fuels are forcing the use of the renewable energy sources. Solar energy is one of the abundant forms of energy available worldwide. It is freely available and environment pollution free. On the geographical status of the places existing of solar energy varies. Solar energy technology is well developed and meets energy demand and also satisfies environmental rules and regulation. Solar energy technology has the huge potential to addition to the fossil fuel and electricity in all seasons .Solar energy can be utilized as a form of heat, such as solar water heating, and as electricity, such as solar photo voltaic.

In India, the dependability on expensive import of crude oil to fulfill its growing energy demand in spite of abundance of solar radiation incidence over it causes to think about non-conventional ways. Because of this reason solar technologies are being utilized to full fill the energy demand. Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. This research is to utilize passive solar technology and by using this technology a conical shaped solar water heater equipped with convex lens has been designed and fabricated and tested for improvement in the system efficiency. The designed prototype is tested under the geographical condition of Mysuru, Karnataka on latitude and the efficiency the system is determined.

PROBLEM DEFINITION

In the present experimental work, the efficiency of the system built is determined

METHODOLOGY

The efficiency of conical shaped solar water heater equipped with convex is determined.

IMPLEMENTATION

The figure shows the experimental setup of the Conical shaped solar water heater, it mainly consists of a main conical solar frame, two water storage tanks and spirally placed tubes. The main conical frame has been fabricated using mild steel. The water tubes have been spirally placed over the frame by welding it to the frame. The tubes have been painted with a light absorptive color (black paint), which collects the heat and transfers the heat to the flowing water. And a double storage system is used, a double unit storage system consists of two storage tanks one being for cold water and other for the hot water storage. The cold water inlet for the tubes is provided from water storage tank placed at a height of about 4ft which gives a suitable head for the water to flow easily. Flow control valves have been connected to the cold water storage tank which controls the flow rate of water through the tubes, the tubes have been tightly fixed to valve using the rings.

The main conical frame along with the tubes is most important part of the solar water heater; it is because of this shape the water gets heated to a maximum temperature by the time it is received at the outlet. Thus the highest possible temperature of the water is achieved by placing the sand between the conical sheet metal and the conical frame. During daytime the sand as well as the black surface collects the heat from sun and store the heat for the future use, the sand retains the heat there by making the heat to be available even in the minimal sunlight.

RESULTS

A conical shaped solar water heater equipped with convex lens has been fabricated according to the design and tested for its performance and following test results were obtained upon experimentation,

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Table: Temperature of Hot Water at Different Time of a Day: (From 22/05/2017 To 28/05/2017)

TIME	COLD WATER TEMP IN ^{O}C	HOT WATER TEMP IN ^{O}C
10AM	28	38
11AM	28	43
12AM	28	43
1PM	30	45
2PM	31	50
3PM	31	49
4PM	31	44
5PM	30	42

Calculation of Solar Energy Transfer to Water

- Total energy available = 5KWH/m^2/day
- Collector area = $\pi d^2/4 = (\pi(0.325^2))/4 = 0.0855m^2$
- Solar energy falling on the collector = 5*0.0855= 1539KJ/day
- Copper tube area =$4*6.5*10^{-3} = 0.026m^2$
- Energy falling on copper tubes = 0.026*1539

Q = 40.014KJ/day.

Assuming that copper tubes absorbs all the amount of energy falling on it and transfers all of the absorbed energy to the water. Therefore energy absorbed by water = 40.014KJ/day.

Experimental Calculation:

Energy absorbed by water = Q = $mc(t_f - t_i)$
= 0.2*4.184*(50-31)
Q = 15.8992KJ
Efficiency = $t_f - t_i / t_i$ = (50-31)/31
$\eta = 61\%$

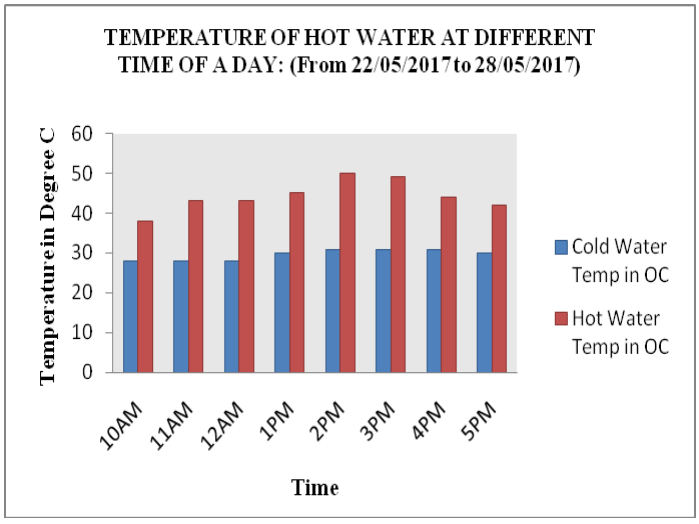

Figure: Temperature of Hot Water at Different Time of a Day: (From 22/05/2017 To 28/05/2017)

CONCLUSION

- The cost of the working model which have fabricated is less when compared to the conventional flat plate collector.
- It consumes less space when compared to flat plate collector.
- The conventional flat plate collector has to be installed in particular direction like in north or south direction only but the model which we have built need not to be placed in such a manner.
- The efficiency of the conical shaped solar water heater equipped with convex lens is 61% which is better when compared to the efficiency of conventional flat plate solar water which is 45%.

SCOPE FOR FURTHER STUDY

- If the system is made using solar tracking system then is system is bound to provide better efficiency.
- A parabolic collector can be used in place of conical shaped collector.

REFERENCES

[1] Ankit S. Gujrathi, Prof. Dilip Gehlot "Testing and Performance of the Convex Lens Concentrating Solar Power Panel Prototype", *International Journal of Emerging Technology and Advanced Engineering* Vol.04, Issue 6, June 2014.

[2] Er.Vinod kumar verma, Vipin Tripathi, Vivek Kumar Verma, Mohd Nuzaif "Development of CSP Using Convex Lenses for Domestic Water Heating", *International Journal of Research in Engineering and Technology*, Vol.03 Issue: 05 May-2014.

[3] Suhas V, Sukeerth Calastawad, Sawan Kumar S, Purujeeth R, Shyam Sharma "Performance of a Conical Shaped Solar Water Heater with that of a conventional solar Water Heater", *International Research Journal of Engineering and Technology*, Vol.02 Issue: 04 June-2015

[4] Naveen Kumar B.K. , Sushma M.S., Raveesha. S "Convex Lens with Transparent Glass Solar Water Heating System", *International Research Journal of Engineering and Technology*, Vol. 05 Special Issue 13 September 2016.

[5] Aminreza Noghrehabadi, Ebrahim Hajidavaloo, Mojtaba Moravej "An experimental investigation of a 3-D solar conical collector performance at different flow rates", *Journal Of Heat And Mass Transfer Research*

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Conical Shaped Solar Water Heater Equipped with Convex Lens

Top and Front view of Conical vessel along with spiral placing of copper tubes along the surface of the conical vessel