CONVEX LENS WITH TRANSPARENT GLASS SOLAR WATER HEATING SYSTEM

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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. The reason of this research paper is to create a convex lens with transparent glass solar water heater prototype, experimentally analyze the system and predict its characteristics when system exposed to the solar behavior of Bangalore, Karnataka, India. Present design from manufacturer and supplier is plane transparent glass solar water heating system. A user of solar energy minimum because cost of the product. With the merits of small structure, less weight, sharp focal length and minimum cost convex lenses are suitable for concentration of solar radiation and system improvement. The efficiency and optical property of transmitted solar radiation is improved and controlled compared to thick normal glass lenses and the solar radiation tracking accuracy need for convex lens group is less compared to other concentration methods.

Keywords: *Convex Lens, Transparent Glass, Solar Water Heating System*

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1. INTRODUCTION

Solar energy is one of the abundant energy availability worldwide. It is freely available and environmental pollution free of alternative source of energy. On the geographical status of the places existing of solar energy varies. For water heating solar thermal energy has been using historically. Thermal energy is the 2nd largest use of energy consumption in the domestic sector and in the commercial sector is 6th largest [1]. A solar radiation falls on to collector, collector absorbs the incident solar radiation in the form of heat and then transfers this heat to fluid used as working medium. Solar energy is used directly or indirectly to heat water by solar water heating system. In smaller capacity of solar water heating system circulation of water is natural or free circulation. By thermosyphon principle free circulation of water in the solar collector and the over head tank is taking place. But in the forced convection system an external source is required; it increases the cost of the system, electricity power consumption also the system design is complex. 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. This research is to create, and fabricate test bench of a convex lens with transparent solar water heating prototype model to check improvement of the collector efficiency in geographical condition of Bangalore, Karnataka on latitude 12.97^0 N.

2. LITERATURE SURVEY

Many researchers were design a flat plate solar water heater and many analysis have been done on free circulation of solar water heating system and many conclusions and characteristics have been shown to improve the performance and efficiency of the system. Most of the natural or free circulation systems are the greater the energy observation, self-regulating and slow circulation [2]. The component of the system is created resistance to flow of water and hot water density in the collector and pipe. Higher collector efficiency factor depend on higher flow rate factor. However, it promotes to higher mixing rate in water chamber and reduction in the overall solar water heating system capacity [3]. The fluid natural circulation rate increases by reducing size of the riser tube and converging shape cross-sectional is used. The water temperature is more and density lighter in the converging riser, because water content in the converging area is less [4]. Various papers reviewed they have tabulated the flow rate importance to the solar collector performance of the solar water heating system. This research, the water flow system is free circulation in solar water heating system is designed and fabricated with the objective of increasing the collector performance and efficiency and its characteristics compare with the conventional flat plate water heating system.

3. SCOPE OF PRESENT WORK

In this present research, modified flat plate solar collector has been decided to design and fabricate a convex lens with

transparent glass solar flat plate water heating system for carry out the performance especially for Bangalore, Karnataka on latitude 12.97^0 N. The intensity of solar radiation is 5.26KWh/m2/day, this is very good as compared to the other places of the India. The capacity of the solar water heating system (SWHS) is 100 liters of water for domestic applications. In this research, natural circulation fluid flow system and concentrating lenses are used for experiment. The capacity of water is 100 liters is stored in collector as stationary. It's designed and fabricated with the goal of increasing the collector performance and efficiency by a factor of temperature of rise in water.

4. MATERIALS AND METHODS

Solar water heater popularity is increases because they are relatively cost reducing and government giving subsidy, technology also reaching mature level [5]. A review study of the existing present solar water heating systems was done. A small minor modification was made on the system to be designed with radiation focus , installation and maintenance cost as well as durability [6]-[10]. Use of indigenous available materials was made an importance of priority. A solar flat plate collector consists of a rectangular box shape container is used as the absorber plate coated with black color and is integrated with the water inlet pipe and water outlet pipe and is placed in an supporting structure with a convex lenses mounted stand. An over head tank and hot water storage tank is containing in the system. The top surface of the water in water chamber in collector gets heated up and recirculation in the water chamber by density difference of hot water layer and cold water layer. The performance and efficiency of collector depends upon the size of concentrating lenses and energy density of solar radiation [6]. All components have been designed and fabricated for experiments and research point of view. The experiments as conducted for several months of days and results were tabulated.

5. Experimental Setup

Solar Radiation Concentrator. Good quality of convex lens made up of optical acrylic material (polymethyl methacrylate, PMMA) was used to concentrate solar radiation. The lens is placed on mild steel frame installation. No solar tracking mechanism.

Table 1: Convex lens specifications.

Size (mm)	190*120
Thickness (mm)	0.4
Grooves (mm)	0.3
Focal distance (mm)	250
Circular focus diameter (mm)	8
Power density (W·cm−2)	26
Solar radiation concentration	1900times
Refractive index	1.49
Transmission (%)	92

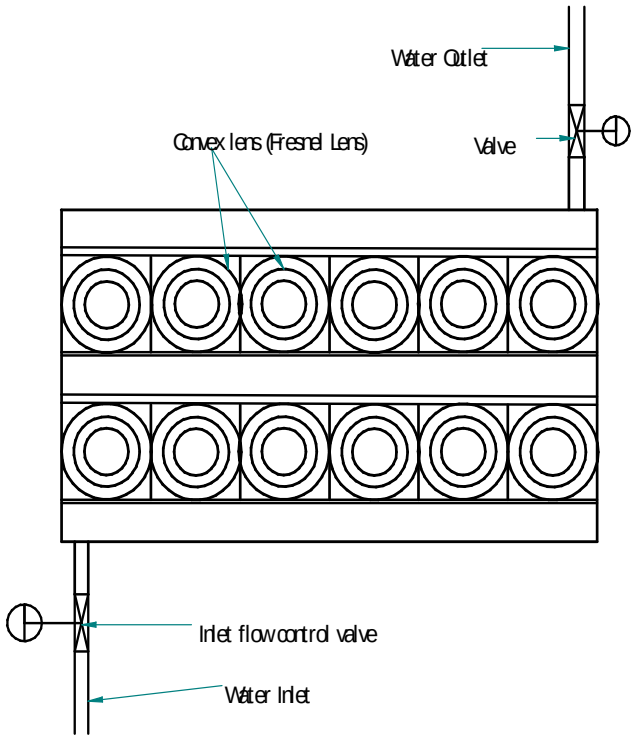

Fig.1: Top view of flat plate solar collector.

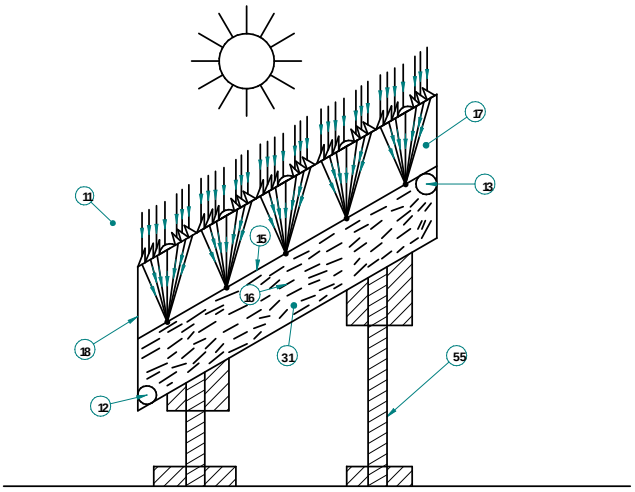

Fig.2: Side view of flat plate solar water collector

Referring to first to FIG. 1 and 2 the present invention provides a solar water heating collector 11 for heating water 16. Collector 11 comprises an array of Convex lenses 14 an absorbing black surface plate 15 disposed below the array of Convex lenses 14 and transparent glass 19. The array of Convex lenses 14 focuses sunlight on absorbing plate 15 to heat specific areas of the absorbing plate. It is to be understood that the array of convex lenses 14 here in column vise or row vise pattern (vertical or horizontal pattern) on top face of the collector 11. Collector 11 also includes a water chamber 31 disposed below the absorbing plate 15. The water chamber contains a water inlet 12 at the footer and water outlet 13 at the header of collector.

As can also be seen, the solar collector 11 is placed at angle of inclination 30^0 to 45^0. The entire water bodies touch to the absorbing plate 15 almost full of water in a chamber 31. Absorbing plate 15 conduct heat then transfer that heat to water by convection, because absorbing metal plate 15 and water 16 direct contact each other.

As can also be seen, the array of convex lenses 14 inserted on top of the collector and adjacent of each convex lenses side fixed the transparent glass 19. Through transparent glass sunrays transmit radiation without concentrating radiation. Non-concentrating radiation falls on absorbing plate, heat up the plate and then transfer to water. Convex lenses 14 and transparent glass 19 is separated from absorbing plate 15 by an air space17.

Fig.3: Assembled solar water heater collector

6. RESULT & DISCUSSION

The following results are obtained and presented in tabular form

Case 1: Convex Lenses Solar Water Heater Collector
On by using Convex Lenses Solar Water Heater collector with using concentrating medium and without insulating water chamber collector there is a gradual increase of temperature but however there is a decrease in temperature after certain time. Reading values and graph are tabulated below.

Month: March-2016.

Capacity of Water: 100 Lts.

Time: 7am to 5pm.

Table 2: Convex Lenses Solar Water Heater Collector

Sl. No.	Date	Ambient Max. Temp. ^{0}C	Ambient Min. Temp. ^{0}C	Water Inlet Temp. ^{0}C	Water Temp. at 2pm ^{0}C	Water Temp. at 5pm ^{0}C
1	1/3/16	32	22	22	55	47
2	2/3/16	31	24	23	51	45
3	3/3/16	33	26	23	56	48
4	4/3/16	34	22	22	55	50
5	5/3/16	33	25	23	56	47
6	6/3/16	33	25	23	54	49
7	7/3/16	33	24	24	56	48
8	8/3/16	34	24	23	57	50
9	9/3/16	35	25	24	60	52
10	10/3/16	34	26	24	55	50

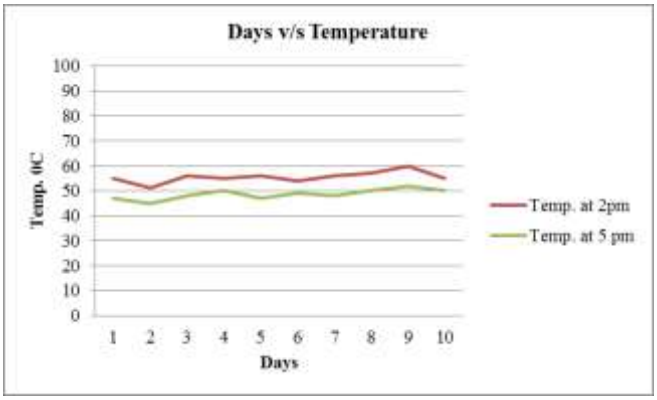

Fig.4: Variation of temperature in Convex Lenses Solar Water Heater Collector.

From the above data predicts the convex lenses solar water heater collector rise water temperature above the half of the boiling temperature. Even if not insulated collector best efficient result is obtained in Bangalore, Karnataka climate.

Case 2: Ordinary Transparent Solar Water Heater Collector
On by using Ordinary Transparent Solar Water Heater without using any concentrating medium there is a gradual increase of temperature but however there is a decrease in temperature after certain time. Reading values and graph are tabulated below.
Month: March-2016.
Capacity of Water: 100 Lts.
Time: 7am to 5pm.

Table 3: Ordinary Transparent Solar Water Heater Collector

Sl. No.	Date	Ambient Max. Temp. ^{0}C	Ambient Min. Temp. ^{0}C	Water Inlet Temp. ^{0}C	Water Temp. at 2pm ^{0}C	Water Temp. at 5pm ^{0}C
1	15/3/16	34	24	24	38	37
2	16/3/16	34	24	24	37	37
3	17/3/16	34	25	24	38	37
4	18/3/16	35	25	24	38	36
5	19/3/16	35	25	25	39	37
6	20/3/16	35	26	25	40	38
7	21/3/16	36	27	25	42	40
8	22/3/16	36	27	25	44	40
9	23/3/16	36	27	25	42	40
10	24/3/16	36	27	25	44	40

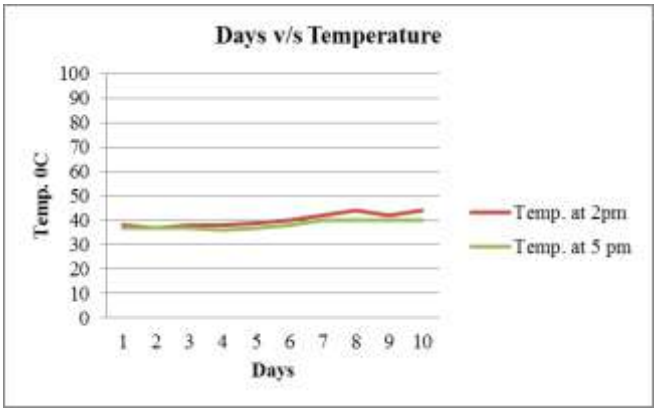

Fig.5: Variation of temperature in Transparent Glass Solar Water Heater Collector.

From the above data predicts the transparent solar water heater collector rise water temperature less than the half of the boiling temperature. For same setup not insulated collector best efficient will after insulating collector, than only obtain best result in Bangalore, Karnataka climate.

7. CONCLUSION

Convex lenses with transparent glass flat plate solar water heater are being fabricated with low cost, as flat plate collector has low efficiency because of diffraction of radiation. By convex lenses with transparent glass flat combination attained maximum efficiency compared to conventional flat plate collector. Safety of system is also not major problem by ventilation of over head pipe with normal safety measures.

8. REFERENCES

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