# Experimental Analysis Of Parabolic Trough Solar Water Heater By Using Different Tube Diameter

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***Abstract- Due to future energy demand in the world it became necessary to focus on the non conventional energy sources. solar energy is a renewable source of energy. Its do not contribute to emission of green house gas and other pollutant to the environment. It is sustainable since it can not be deplete in a time relevant to primary source oil. Coal, gas. In this paper new parabolic through solar water heater system with manual tracking system has been developed for hot water generation .parabolic trough is fabricated by cutting, welding of stainless steel sheet. Which covered by aluminium foil which work as a reflector. Two copper tube of varying diameter for absorbing were taken .experiment conducted on different diameter tube along with changing focal length of collectors so that maximum heat transfer from the receiver achieved performance evaluation of this system has been done during the month of December 2015 (winter season) at Gwalior (m .p.) (26.22 N latitude, 78.10 E longitude.)***

***Keywords- parabolic trough solar collector, reflector, two absorber tube, glass tube.***

## I. INTRODUCTION

Solar energy is the primary source of energy for our planet. The solar power where sun hits atmosphere is $10^{17}$ watts the solar power on the earth surface is $10^{16}$ watts. The total world-wide power demand of all need of civilization is $10^{13}$ watts. There for sun gives we 1000 times more power than we need. If We can use 5% of this energy, it will be 50 times what the world requires. The energy radiate by the sun on a bright sunny day is approximately $1kw/m^2$ in this experiment alternative use of solar energy has been studied. Solar energy is a high temperature high energy radiant energy source with huge advantage over other alternative energy sources it is reliable, domestic, robust, renewable source with large undeveloped potential, and emit essentially none of the atmospheric emission that are dangerous for human race [1].

In this study the design and fabrication of parabolic through solar water heater for water heating was executed. The procedure employed Include the design construction and testing at different flow rate and find optimum flow rate at which maximum outlet temperature attain. The incident solar radiation falling on collector is reflected by aluminum foil is utilized for piping heating inside the pipe. The thermal fluid flow and its temperature increase due to the incoming radiation a vacuum is created around the pipe by covered with glass tube. Test is carried on change the diameter of copper tube along with different focal length of collector. Calculate outlet temperature of fluid. Find that large diameter pipe gives more temperature due to large area covered by the fluid. Efficiency of parabolic is a function of outlet temperature, pipe diameter, intensity of Solar radiation. The improvement achieved at this project generates a new method to reduce the logistics times and labor for this type of solar thermal system as well as manufacturing cost [2].

While fossil fuels (coal, oil & gas) will be the main fuels for energy. There is a fear they will get exhausted eventually in the next century. There for other system based on non conventional and renewable sources are being tried by many countries. In India the energy problem is very serious. In spite of discoveries of oil and gas off the west coast, the import of crude oil continues to increase and the price paid for it now dominates all other expenditure. One of the promising options is to make more extensive use of renewable sources of energy derived from the sun. Solar energy can be use used both directly and indirectly. It can be used variety of thermal application like heating water, drying, and distillation [3]

## II. SYSTEM MODEL

Fig 2.1 experimental setup

Fig 2.2 two copper tube of different diameter

Lists Of The Parameter Used In The Experiment Setup

Table 2.1 lists of the parameter used in the Experiment Set up

| Parameter | Value |
|---|---|
| 1. aperture length | 0.75 m |
| 2.collector length | 1.25 m |
| 3. aperture area | $0.75m^2$ |
| 4.Diameter of first tube | 19 mm |
| 5.Diameter of second tube | 14 mm |
| 6.First focal length | 240 mm |
| 7.Second focal length | 190 mm |
| 8.Diameter of glass tube | 25 mm |
| 9.water flow rate | 0.01kg/s |
| 10.rim angle | 90 |
| 11. Absorber tube emissivity $\alpha$ | 0.78 |
| 12. Glass tube transitivity $\tau$ | 0.88 |
| 13. Aluminum foil reflectivity $\rho$ | 0.93 |

## III. PREVIOUS WORK

Vijayaraghavan et al. [4] – have carried out reports on the outdoor testing done to verify performance of a spectrally selective liquid under concentrated light. The design consists of a Fresnel lens based concentrator that focuses radiation on to a glass absorber. Collector thermal performance was measured using copper sulfate solution as the heat collection fluid. Effect of various parameters on efficiency is also reported. It was found that parameter such as solution flow rate through the absorber and optical concentration as measured by the spot size have an insignificant impact on the thermal performance.

Mintsa Do Ango et al. [5] - this work presents numerical simulations aimed at optimizing the design of polymer flat plate solar collectors. Solar collectors' absorbers are usually made of copper or aluminum and, although they offer good performance, they are consequently expensive. In comparison, using polymer can improve solar collectors' economic competitiveness. In this paper they propose a numerical study of a new design for a solar collector to assess the influence of the design parameters (air gap thickness, collector length) and of the operating conditions (mass flow rate, incident solar radiation, inlet temperature) on efficiency.

Kumar Alok. [6] Cylindrical concentrator and a receiver tube. The selective cover system prevents the heat loss (convective and radiative) from the receiver tube and parabolic trough type collector consists of selective improves the performance of solar parabolic trough Also evacuated chamber is created to reduce the loss of heat and reduce the corrosion of concentrator surface. Tracking system is embedded in the solar parabolic trough for tracking the sun energy movement. This report presents the evaluation of solar insolation in terms of monthly average hourly global radiation in Patna on 10th April, 2013. On the basis of this solar energy flux, comparative study of the instantaneous efficiency of solar parabolic trough is done. Here four different types of cover system are mathematically analyzed. (i) Single glass cover on receiver (ii) Double glass cover on receiver (iii) Single glass cover on aperture (iv) Double glass cover on aperture. This report contains many graphs to illustrate the effect on instantaneous efficiency on variation of primary parameter. With the help of MATLAB R201a software mathematical calculation is obtained.

Ruby et al. [7] performed through the design, construction, operation, and analysis of a high temperature solar thermal system at a Frito-Lay snack food plant located in Modesto, California. In this installation, high temperature water is produced by a concentrating solar field, which in turn is used to produce approximately 300 pounds per square inch (20 bar) of process steam. Process steam in the plant is used for cooking, which includes heating edible oil for frying, and heating baking equipment. Steam is also converted into hot water for cleaning and sterilization processes

Sagade et al. [8] conducted experiment on parabolic trough made of fiberglass-reinforced plastic with its aperture area coated by aluminum foil with a reflectivity of 0.86. This line-focusing parabolic trough with mild steel receiver has been tested with and without glass cover. From Indian conditions, low-cost FRP parabolic trough system proves to be beneficial for industrial heating applications as well as domestic heating.

## IV. EXPERIMENTAL METHODOLOGY

Hot water use and needs increase day by day due its use domestic, commercial, industrial etc. electrical water heater, or other way for hot water generation like coal , oil accessible in industrial or commercial purpose but for domestic purpose or ruler area this is costly and required

intensive care. For it. Solar water heater is best substitute for hot water generation due to its low fabrication and operation cost. In eclectic heater danger by electric shock but in case solar water free from it. After the prepared of final setup, we have used following research methodology for these experiments are as:

(1) First, established set up at top of the roof and matched best sun angle.

(2) Took reading at different flow rate and measure temperature and set final flow rate on which we got maximum temperature.

(3) Took four reading in four days in winter season at Gwalior (m .p) from 10.00 am to 4.00 pm (a) 18 mm dia. Tube at 240 mm focal length (b) 14 mm dia. Tube at 240 mm focal length (c) 18 mm Die .Tube at 190 mm at focal length (d) 14 mm dia. Tube at 190 mm at focal length. Were four Reading.

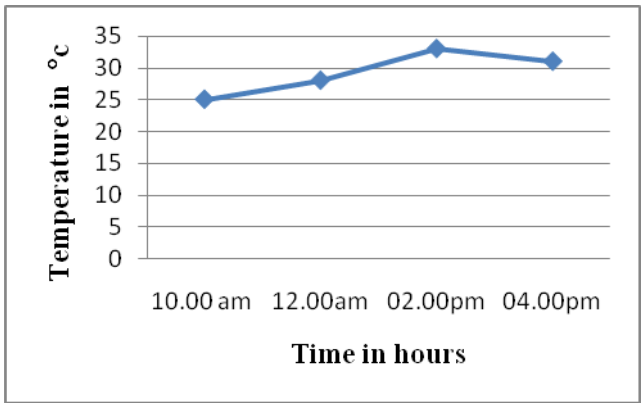
(4) These experiment gives data like outlet temperature, receiver temperature, ambient temperature etc. All the observation and result of these experiments is shown below.

Table 4.1 Detail of Experiment

| | | |
|---|---|---|
| 1 | Place of Experiment Perform | Kampoo, Gwalior (M.P.) |
| 2 | Date of Experiment Perform | 05/12/2015, 07/12/2015, 10/12/2015, 13/12/2015 |
| 3 | Flow rate | 0.1 kg/s |
| 4 | Gwalior Climate Condition | 26.22N latitude, 78.10E longitude |
| 5 | Season | Winter |

## V. EXPERIMENTAL RESULTS

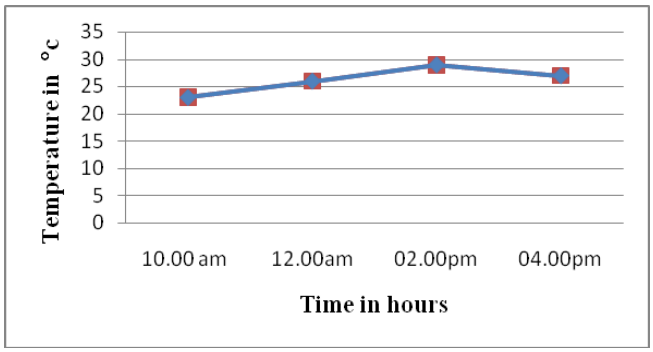
### 5.1 Variation of temperature with time




**Case – 1** Experiment is conducted by using 19mm dia. Tube at 240mm focal length on 05/12/2015 from day timing 10.00 am to 4.00 pm

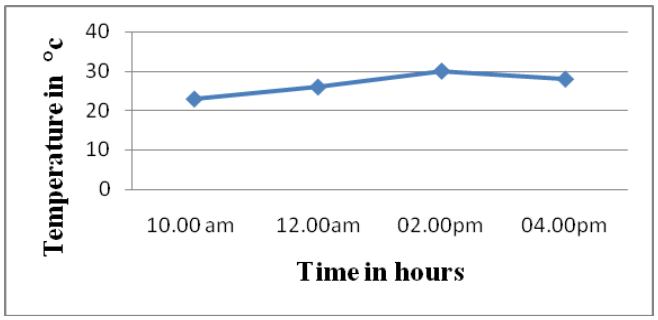
### 5.2 Variation of temperature with time

**Case – 2** Experiment is conducted by using 14mm dia. Tube at 240mm focal length on 07/12/2015 from day timing 10.00 am to 4.00 pm



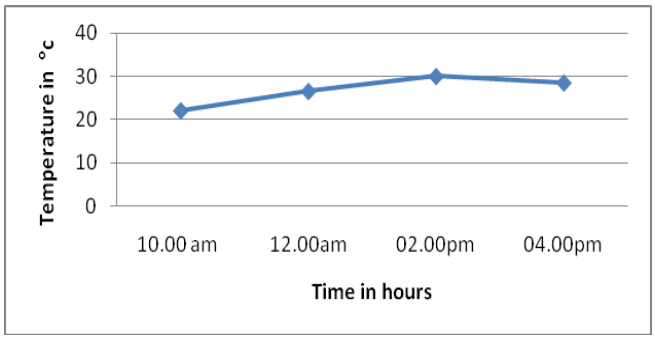

### 5.3 Variation of temperature with time

**Case – 3** Experiment is conducted by using 19mm dia. Tube at 190mm focal length on 10/12/2015 from day timing 10.00 am to 4.00 pm

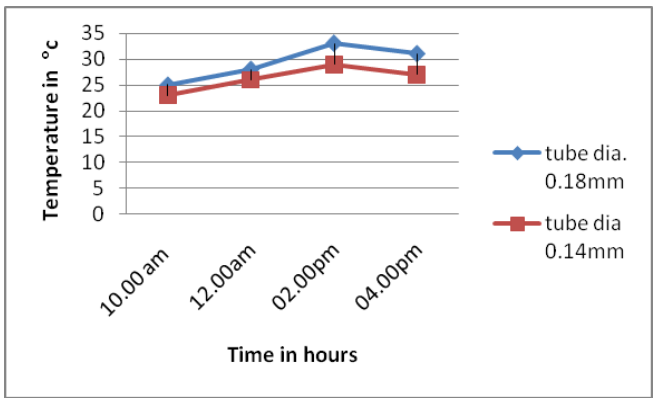



### 5.4 Variation of temperature with time

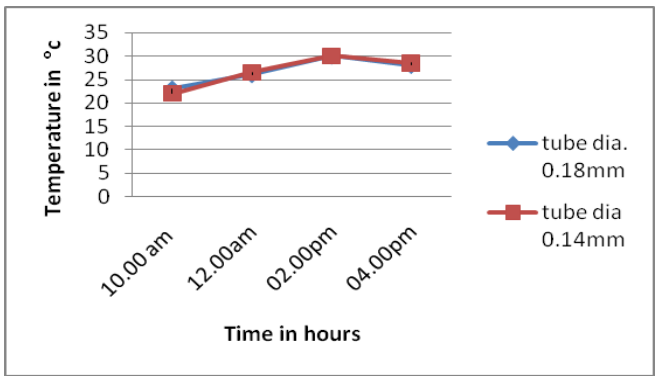
**Case – 4** Experiment is conducted by using 14mm dia. Tube at 190mm focal length on 13/12/2015 from day timing 10.00 am to 4.00 pm



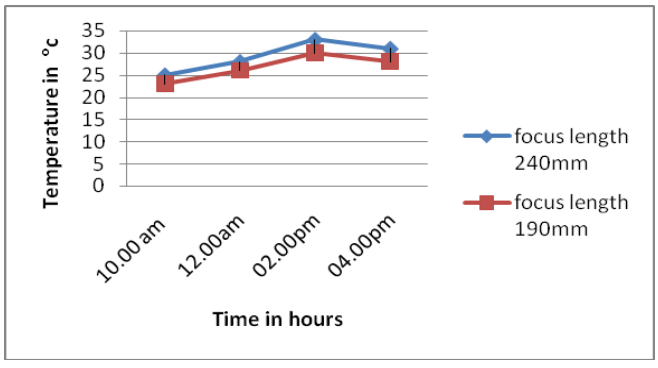

### 5.5 Combined variation of temperature with time at focal length 240mm



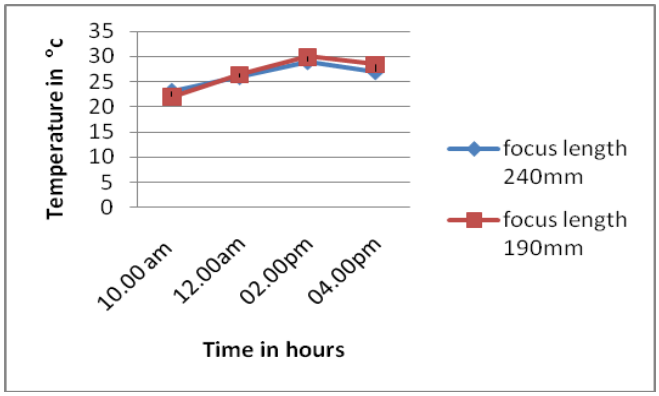

**5.6 Combined variation of temperature with time At focal length 190mm**




**5.7 Variation of temperature with time for tube dia. 18mm**




**5.8 Variation of temperature with time for tube dia. 14mm**




## VI. CONCLUSION

We have got maximum temperature on 19 mm diameter tube at 240 mm focal length at 2 O'clock which is 33 c It is about 10% more than from 14 mm diameter tube at same focal length.

## VII. FUTURE WORK

Future work in this experiment may be to change reflector material like mirror film or any other metallic film which have high reflectivity. Experiment can be done in summer season for better efficiency of collector. This system is work for water heating we can also generate electricity by used solar cells in place of absorber and stored in battery. For vacuum can be use another material instead of glass tube.

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