

“Comparison between flat plate collector and flat plate with square embossing along with aluminium foil in solar water heater”

Vraj mistry¹, Harshil Chudasama², Rahul Desai³

¹ student of Mechanical Department , Samarth collage of engineering and tech., Himmatnagar, Gujarat, India

² student of Mechanical Department , Samarth collage of engineering and tech., Himmatnagar, Gujarat, India

⁵ Assistant Professor of Mechanical Department Samarth collage of engineering and tech., Himmatnagar, Gujarat, India

ABSTRACT

As we know sun is source of all energies available on the earth. The major advantage of solar energy when compare to alternate energies is that it is available in lot amount of throughout the year and the best application of it is for heating and energy generation. The main objective of present work is to develop such solar water heater in which the absorber plate with square embossing shape and with it a aluminium foil at the wall of the box in which all part mounted Also in addition to this cavity, which is developed is filled with various heat absorbing materials i.e sand, salt, and powder of glass. The thermal performance of this solar water heater will be evaluated with the help of "K" type thermocouple with appropriate location.

Keyword: - solar water heater, square embossing, aluminium foil, and black sand etc....

1. Introduction

Solar energy is beaming light and heat from the Sun is developed using a wide range of technologies likely solar heating, photovoltaic, solar thermal energy, solar framework and artificial photosynthesis. It is one of the most mandatory source of non-conventional energy and it's technologies are vastly classified as passive solar or active solar which depends on the way they capture and parcel solar energy or it's conversion into solar power. Active solar channels include the use of photovoltaic systems, full-boided solar power and solar water heating to develop energy. Passive solar techniques comprises of initiating a building to the Sun, selecting materials with responsive thermal mass or light dissipating properties, and designing spaces in which air circulates naturally.

1.1 Basic Flat plate 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.

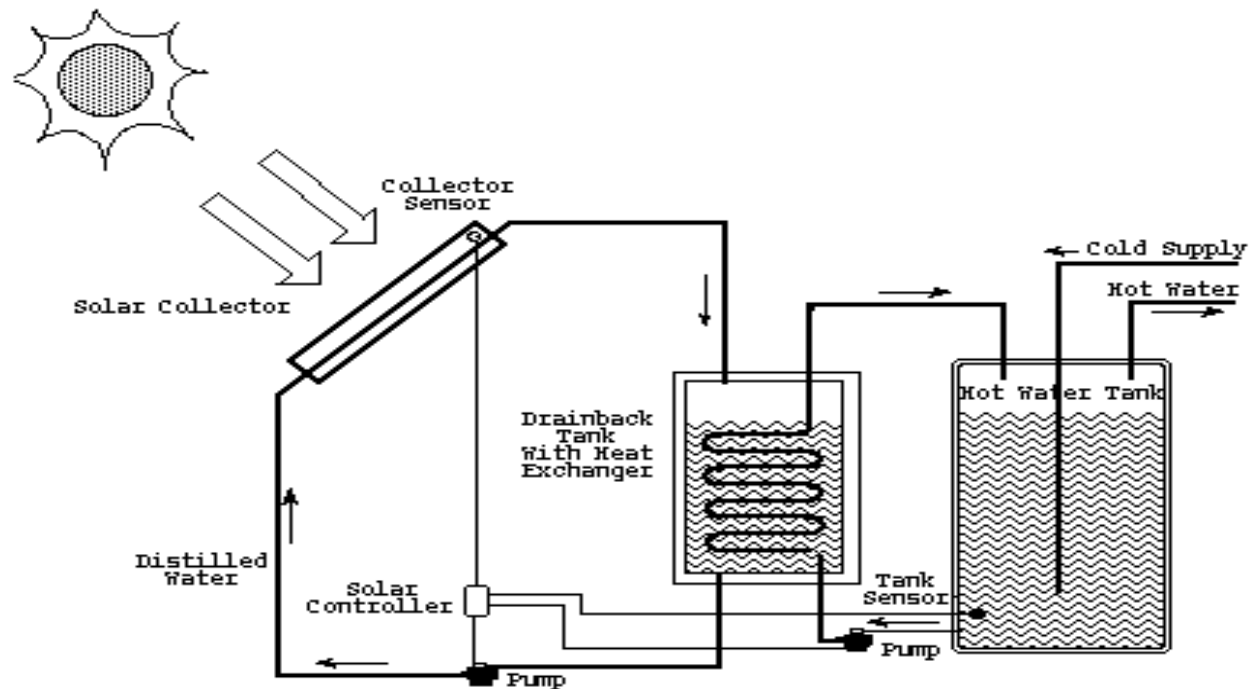


Fig 1 Simple solar water heater with flat plate collector.

1.2 Aim and Objectives of project

Aim: To perform experiment on embossed type Solar water heater and evaluate its thermal performance individually as well as comparatively.

Objectives:

- The thermal performance of this solar water heater will be evaluated with the help of “K” type thermocouple with appropriate location.

The effect of various embossing shape on the performance of solar water with and without using black-sand to enhance the performance of solar water heater.

2. DESCRIPTION OF SYSTEM

In traditional Solar water heater systems the normal flat plates were used for collecting the Solar radiation and using that to heat the water by the conduction and convection. So we came on the decision of making the modification in the absorber plate by creating embossed shapes on the surface of absorber plate and fill up the cavity with some heat holding material like sand. The embossed shapes were square. The dimensions of the whole arrangement was same the additionally aluminium foil is used and the embossed plates were being replaced in order to compare which shape provides more efficiency and which one has more heat holding capacity flat plate or square embossed,

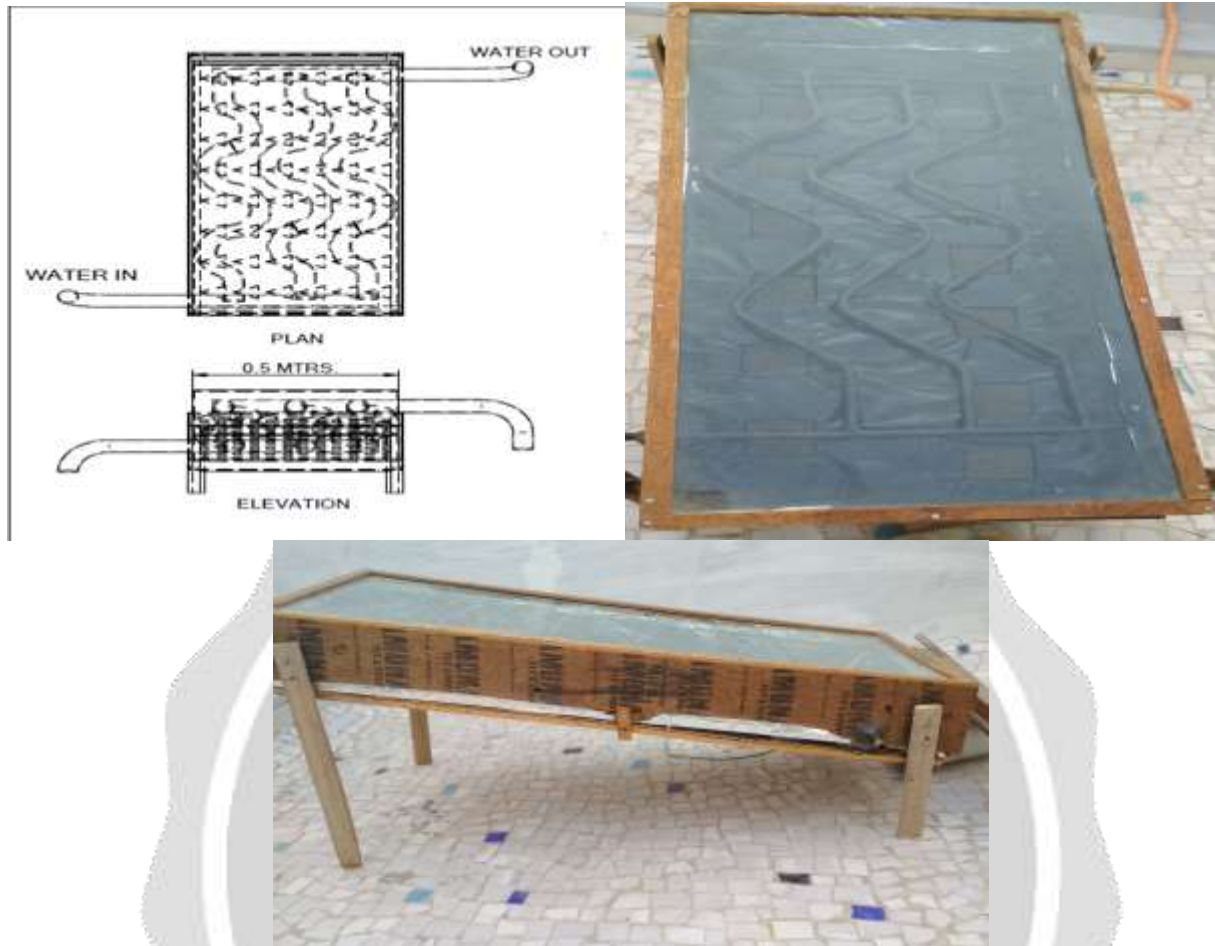


Fig –experimental set-up

This is the main model of the current experiment and only the absorber plates were made with square shapes. The serpentine shapes copper pipes were used in order to make the flow passage, Serpentine shape was given in order to provide more turbulence so that the fluid passing through can absorb more of heat through conduction and convection phenomena of heat transfer.

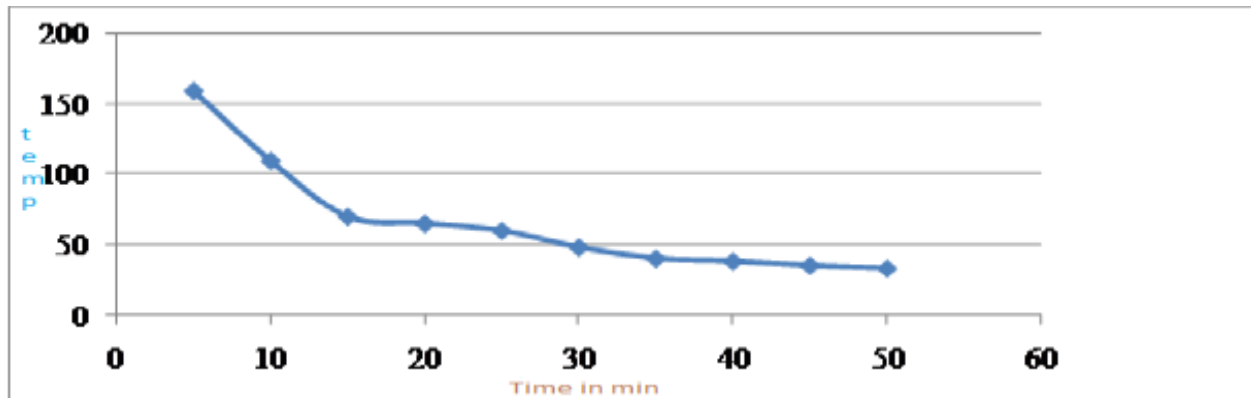
2.1 Working principle

The solar water heater is kept at angle of 30° inclination in order to attain the full effect of solar radiation and conduction and convection through the water flow through the pipe is by the effect of thermosyphon which occurs due to the density difference. Due to serpentine shaped pipes the turbulence is created and the flow inside the pipe gets mostly all the heat. The sand on square embossed shape is helps to increasing heat holding capacity of collector plate.

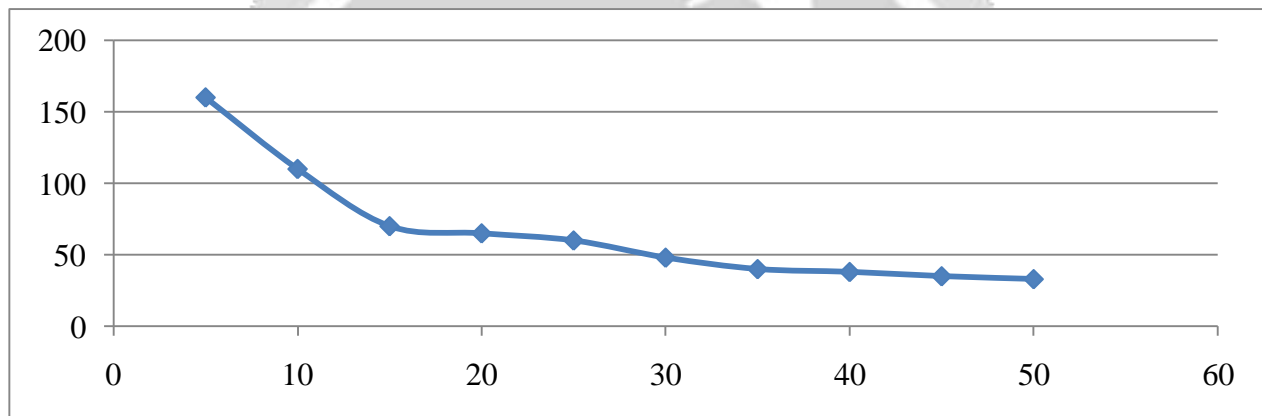
2.2 Heat holding capacity of different material

The material where tested to get the information about the heat loss phenomena during a period of time. The materials where SAND, POWERED GLASS and NORMAL SALT. All the materials where tested for the time interval of 10 minutes. The graphical representation is as show in figures below. Also the material will be selected on the basis of performance of absorptivity along with the heat holding capacity over a period of time.

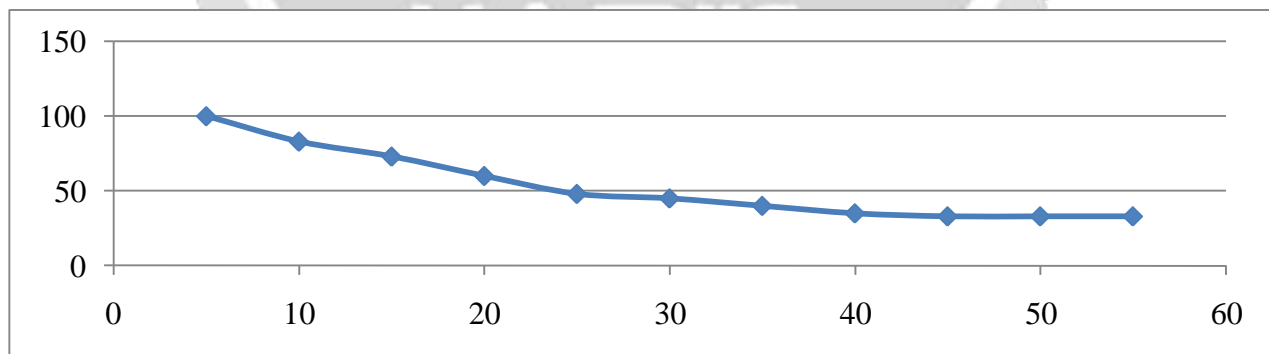
Sand



Powdered glass



Normal salt



Conclusion of material testing

From the above mentioned graphs we can see that the heat loss in SAND is very less compared to the other two materials over a fixed duration of time. Hence we would most likely select the SAND as the filler material in the cavity of embossed shapes.

3. TEST RESULT

3.1 Theoretical calculation

- The intensity of solar radiation is given as follows

$$I = [1 + 0.033 \cos (360 \times n / 365)]I_{sc}$$

- Efficiency of the SWH is $\eta = \frac{Q_{out}}{Q_{in}} = \frac{mC_p\Delta T}{I \cdot A}$
- m= 1000ml / time
- C= 4.187 KJ/Kg k (assumed constant)

Comparison of square embossed plate and flat plate

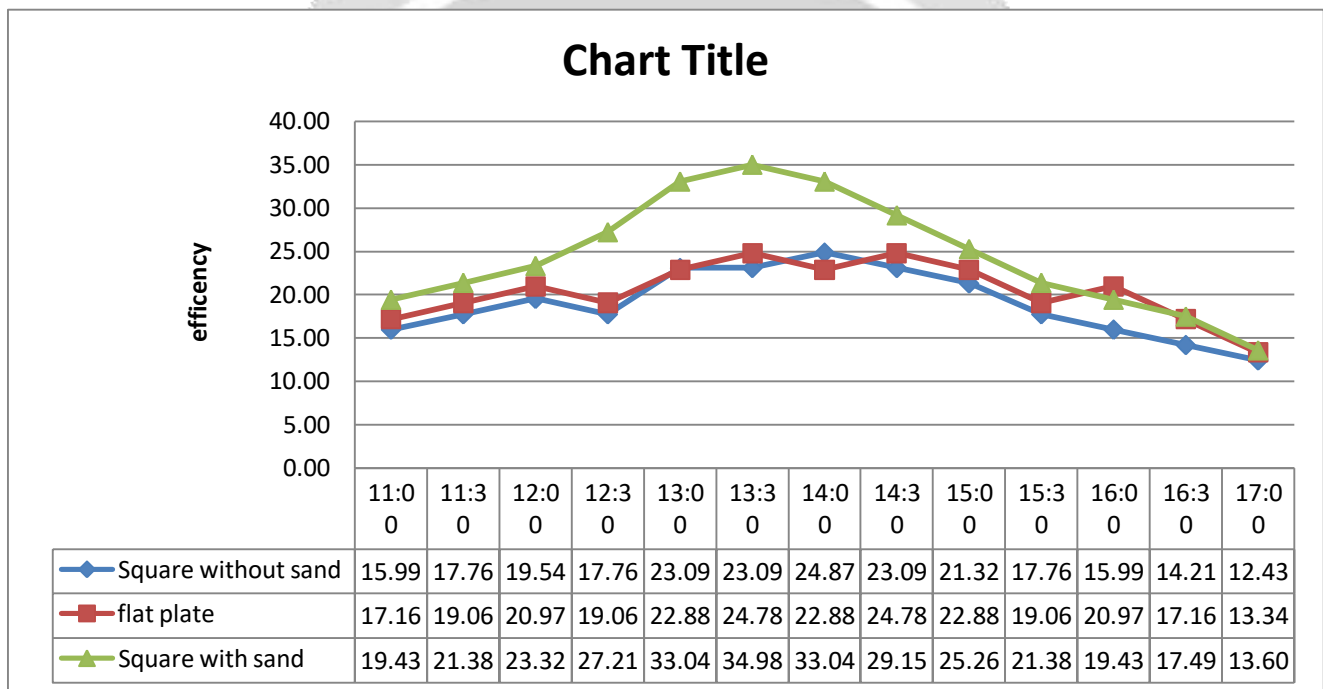


Figure Comparison of square embossed plate and flat plate

4. CONCLUSIONS

From this line chart we can see that the efficiency of square with sand is higher from 11.00am in comparison to the other two cases which are flat plate and square without sand.

The overall efficiency of square plate with sand is 24.52% which higher in comparison to that of square without sand which is 18.99% and also higher from flat plate which is 20.42%. Hence from this chart we can that square with sand is having more effect in the overall efficiency of the solar water heater

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- [2].Rakesh Kumar*, MarcA.Rosen Faculty of Engineering and Applied Science, University of Ontario Institute of Technology, 2000 Simcoe Street North Oshawa, Ontario L1H 7K4, Canada
- [3].K.K. Chong*, K.G. Chay, K.H. Chin Faculty of Engineering and Science, Universiti Tunku Abdul Rahman, Off Jalan Genting-Kelang, Setapak, 53300 Kuala Lumpur, Malaysia
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