IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ANALYSIS OF SOLAR WATER HEATER EFFICIENCY WITH BAFFLED PIPE AND SMOOTH PIPE

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ABSTRACT: One of the alternatives to reduce the consumption of electricity for heating water is by popularizing the use of solar energy and work contributes with studies on low cost solar heater. The solar collector, which absorb solar energy and transfer it to water in the form of heat. The aim of this project is to improve the thermal performance of natural convective. The project work focuses on the process of energy conversion from the collector to the working fluid (water). This is accomplished by employing six channels of GI pipes inside the collector to induce a gradient of heat capacitance. It helps to analyse the effect of baffled pipe in solar water heater. The efficiency of solar water heater is less when using smooth pipe in comparison of baffled pipe. Water is stagnant at the inner circumference of the smooth pipe when water heat take place due to this reason baffled pipe used , it produce turbulent in the flow of water and help to increase the efficiency of solar water heater.

Keywords- GI pipes, baffled pipe, turbulent.

INTRODUCTION: Solar Water Heater is a device that helps in heating water by using the energy from the SUN. This energy is totally free. Solar energy (sun rays) is used for heating water. Water is easily heated to a temperature of 60-80 C. Solar Water Heaters (SWHs) of 100-300 litres capacity are suited for domestic use. Larger systems can be used in restaurants, canteens, guest houses, hotels, hospitals etc. A 100 litres capacity SWH can replace an electric geyser for residential use and may save up to 1500 units of electricity annually. The use of 1000 SWHs of 100 litres capacity each can contribute to a peak load saving of approximately 1 MW. A SWH of 100 litres capacity can prevent emission of 1.5 tonnes of carbon dioxide per year. SWH is approve and readily available technology use renewable energy for conventional water heating. A lot of types of SWH are available and can be used in much application. Domestic hot water usually uses small system applications while larger systems are used in industrial applications. There are two types of water heating systems based on the type of the circulation: natural circulation and forced circulation. Natural circulation solar water heaters are simple in design and low cost. Forced circulation water heaters are used in freezing climates and for commercial and industrial process heat. Solar water heating is the direct use of solar energy that has been practiced most extensively in the last two decades. It is the most viable of all low-temperature

solar energy applications; it will probable be the first wide use of solar energy in near future because the initial investment is small and the system is used throughout the year (in the developed countries). The high use factors results in a larger load factor than in a solar heating system. Solar hot water heating components are now available commercially.

Solar water heaters are made up of collectors, storage tanks, and, depending on the system, electric pumps. There are basically three types of collectors: flat-plate, evacuated-tube, and concentrating. A flat-plate collector, the most common type, is an insulated, weatherproofed box containing a dark absorber plate under one or more transparent or translucent covers.

Evacuated-tube collectors are made up of rows of parallel, transparent glass tubes. Each tube consists of a glass outer tube and an inner tube, or absorber, covered with a selective coating that absorbs solar energy well but inhibits radiative heat loss. The air is withdrawn ("evacuated") from the space between the tubes to form a vacuum, which eliminates conductive and convective heat loss. Concentrating collectors for residential applications are usually parabolic troughs that use mirrored surfaces to concentrate the sun's energy on an absorber tube (called a receiver) containing a heat transfer fluid . Most commercially available solar water heaters require a well-insulated storage tank. Many systems use converted electric water heater tanks or plumb the solar storage tank in series with the conventional water heater. In this arrangement, the solar water heater preheats water before it enters the conventional water heater. Some solar water heaters use pumps to recirculate warm water from storage tanks through collectors and exposed piping. This is generally to protect the pipes from freezing when outside temperatures drop to freezing or below.

EXPERIMENTAL SET UP:

Fig- 1 (experimental set-up)

Fig-2 (Inside view of pipe)

MAJOR COMPONENTS OF THE SETUP:

1.) Pyranometer. 2) Water tank 3.) Thermocouples. 4.) Milli-voltmeter. 5.) Glazing. 6) Absorber plate.

EXPERIMENTAL PROCEDURE:

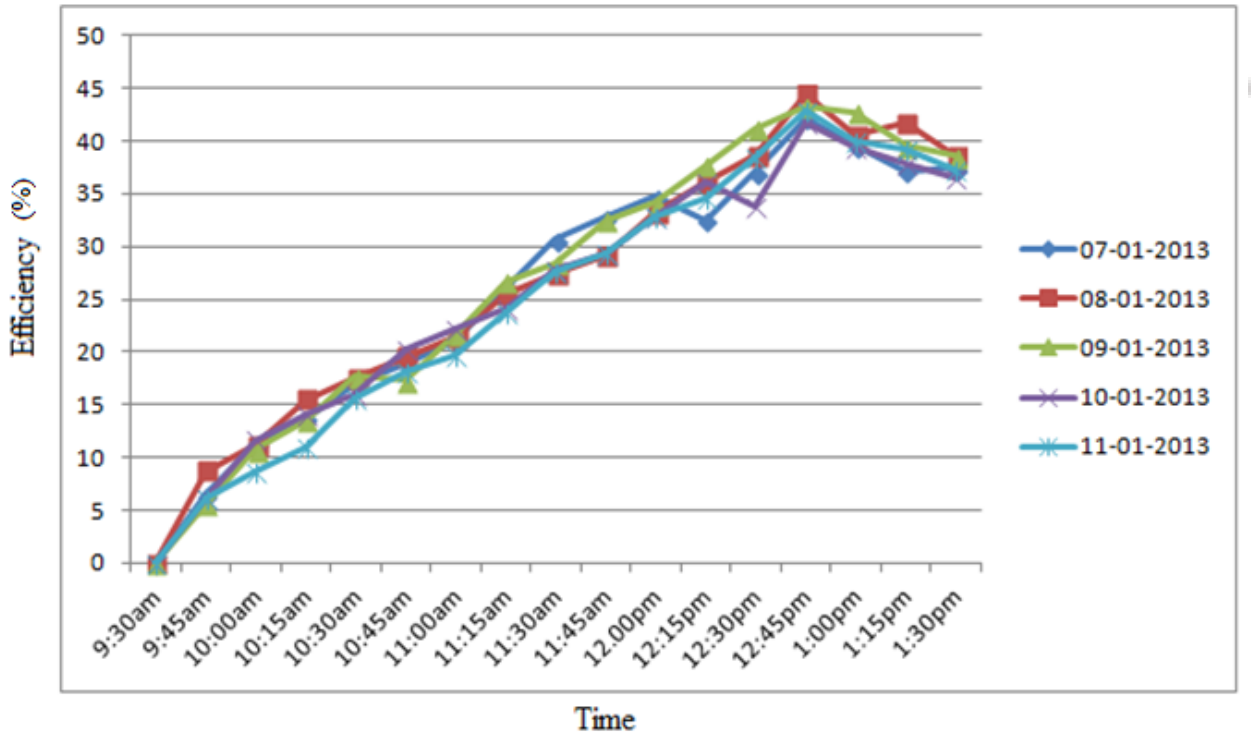
The solar collector installed with water tank was at various angles (20.5°, 18.2°, 15.4°, 15.7°, 14.3°, 15.3°, 17.6°, 16.5°, 15.2°) on each day of observation. The complete system was oriented in the South direction.

The Pyranometer is a device which measure short wave radiation. It was connected at same slope to as the solar collector to read radiation flux (W/m^2) on the inclined surface (as shown in figure).By the use of intensity meter, the output reading of pyranometer was converted into a heat flux using the calibration relation (1mV= $129W/m^2$) provided by the manufacturer.

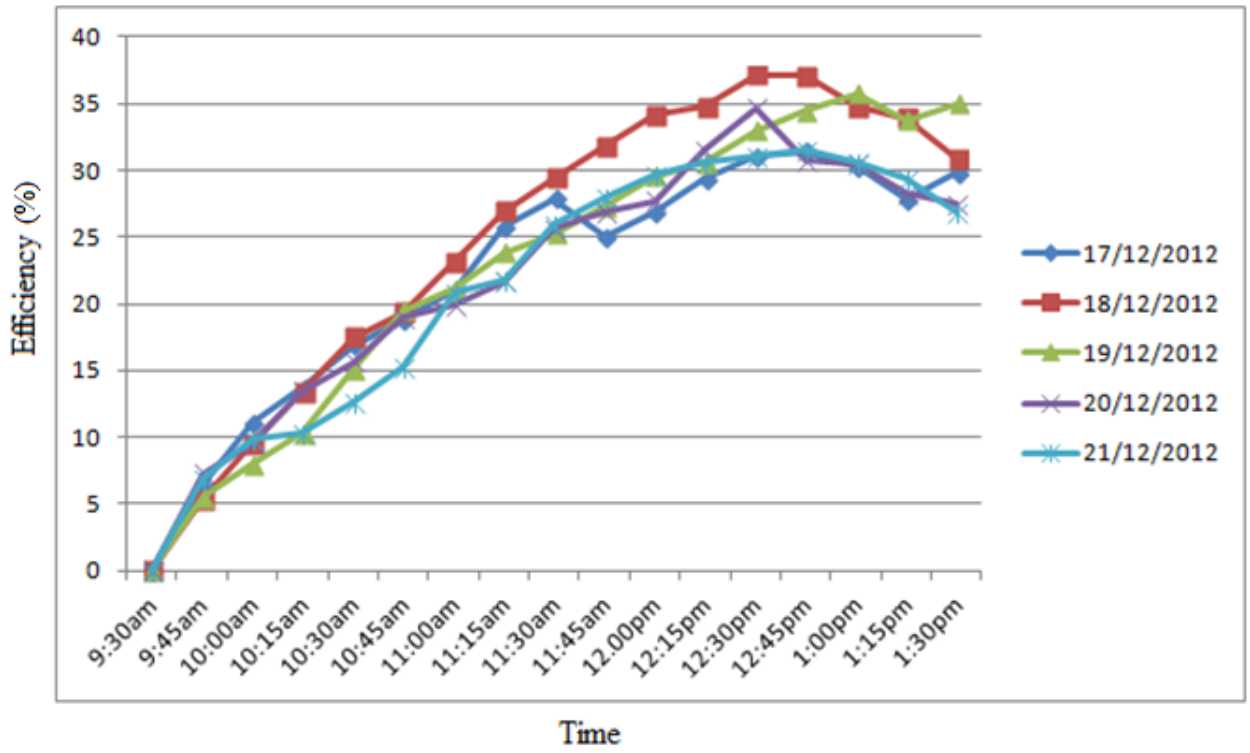
There were seventeen readings obtained in interval of fifteen minutes each day by the use of thermocouple and digital temperature indicator i.e. T_1 , T_2 ,T_3 ,T_4 . T_1 is the inlet water temperature and T_2 outlet water temperature value of solar collector. T_3 is temperature of upper layer water and T_4 is the temperature of lower layer of water in the water tank. In addition two thermocouple was connected which give the reading of temperature of absorber plate (T_5) and ambient temperature (T_6).

These six readings were made through the use of J-type thermocouple.

Once the unit was connected, it was left to run for about 3 days before the recorded measurements are taken, in order to overcome the initial transient's effect and to conform reliable operation unit. Then the experiment was run for period of 5 days on **smooth pipe** and five days of **baffled pipe.** Aluminium sheet is absorber plate. Data was taken from the period of 17/12/2012 to 21/12/2012(smooth pipe) and from 7/01/12013 to 11/01/2013 on (baffled pipe).



Efficiency V/s Time using when baffled –pipe



Efficiency V/s Time when using smooth pipe

CONCLUSION:

The following conclusions may be drawn from this study:

1.) When ambient temperature increases, the temperature of mean water temperature. It reaches maximum value at a maximum ambient temperature around noon. After it ambient temperature and water temperature start to decreases.
2.) Heat energy absorbed by water, Nusselt number, Raleigh number convective heat transfer coefficient from 9:30AM to around noon increases gradually and then decreases after noon in both cases of pipe condition, studied here.
3.) The daily average heat energy and daily efficiency of solar water heater with smooth pipe and baffled pipe are higher in the case of baffled pipe.
4.) When temperature increase friction factor start to decreases and is minimum about noon and increases with decreases in temperature.

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