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Fabrication and Analysis of Hybrid Water Heating System

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ABSTRACT: Solar water heating (SWH) or solar hot water (SHW) systems comprise several innovations and many mature renewable energy technologies that have been well established for many years. In these days of power shortages non-conventional and renewable sources of energy are gaining importance. India, with its tropical climate, can tap Solar energy for heating water for domestic & industrial purposes & various non-heating purposes, like street lighting etc. At higher latitudes, solar heaters may be less effective due to lower solar energy, possibly requiring larger and/or dual-heating systems. In addition, government incentives can be significant. The cost varies significantly in different regions depending on the requirements of the customer and also the capacity of the storage tank. The transport cost also plays an important role in shifting of the equipment to a remote places.

KEYWORDS: Solar water heater, Solar flat plate collector, Gas geyser, Heater coil.

I. INTRODUCTION

The non-convectional water heating system based on solar energy has a major advantage in that, once the initial installation is carried out, the consumer will have minimum recurring expenditure. This system consists of collector panels of 2M X 1M, a cold water tank & insulated piping. If a stainless steel tank is installed, the water thus heated can be stored in those tanks, in 100, 200 & 250 lps for domestic purposes & 1000, 2000 & 3000 lps for non-domestic segments like hotels, hostels etc. SWH systems are designed to deliver hot water for most of the year. However, in winter there sometimes may not be sufficient solar heat gain to deliver sufficient hot water. In this case a gas or electric booster is normally used to heat the water. Hot water heated by the sun is used in many ways. While perhaps best known in a residential setting to provide domestic hot water, solar hot water also has industrial applications.

When a solar water heating and hot-water central heating system are used in conjunction, solar heat will either be concentrated in a pre-heating tank that feeds into the tank heated by the central heating, or the solar heat exchanger will replace the lower heating element and the upper element will remain in place to provide for any heating that solar cannot provide. However, the primary need for central heating is at night and in winter when solar gain is lower. Therefore, solar water heating for washing and bathing is often a better application than central heating because supply and demand are better matched. In many climates, a solar hot water system can provide up to 85% of domestic hot water energy. This can include domestic non-electric concentrating solar thermal systems. In many northern European countries, combined hot water and space heating systems are used to provide 15 to 25% of home heating energy..

II. LITERATURE SURVEY

There are records of solar collectors in the United States dating back to before 1900, comprising a black-painted tank mounted on a roof. In 1896 Clarence Kemp of Baltimore, USA enclosed a tank in a wooden box, thus creating the first 'batch water heater' as they are known today[1][2]. Although flat-plate collectors for solar water heating were used in Florida and Southern California in the 1920s there was a surge of interest in solar heating in North America after 1960, but especially after the 1973 oil crisis[5][6].

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The world saw a rapid growth of the use of solar warm water after 1960, with systems being marketed also in Japan and Australia. Technical innovation has improved performance, life expectancy and ease of use of these systems[3]. Installation of solar water heating has become the norm in countries with an abundance of solar radiation, like the Mediterranean, and Japan and Australia. Colombia developed a local solar water heating industry thanks to the designs of Las Gaviotas, directed by Paolo Lugari[7][8][9].

Driven by a desire to reduce costs in social housing, the team of Gaviotas studied the best systems from Israel, and made adaptations as to meet the specifications set by the Banco Central Hipotecario (BCH) which prescribed that the system must be operational in cities like Bogotá where there are more than 200 days overcast[10]. The ultimate designs were so successful that Las Gaviotas offered in 1984 a 25 year warranty on any of its installations[12][13]. Over 40,000 were installed, and still function a quarter of a century later. Australia has a variety of incentives (national and state) and regulations (state) for solar thermal introduced starting with MRET in 1997[11][14].

III. HYBRID WATER HEATING SYSTEM

The final design includes following equipment namely

1. Solar flat plate collector
2. Gas geyser
3. Electrical heater coil
4. Digital temperature indicator

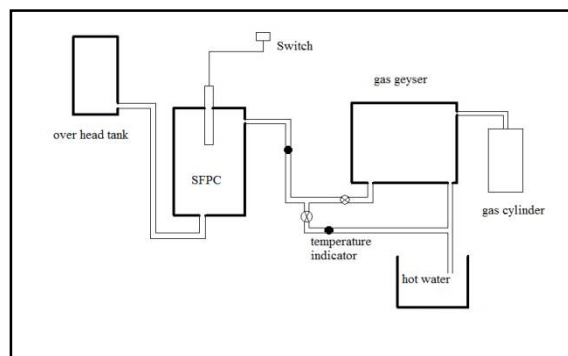


Fig.1 Block diagram of hybrid water heating system

Solar flat plate collector

The liquid flat plate collector is the most widely used solar collector because it is simple in design, has no moving part and requires little maintenance.

The basic parts that make up a conventional liquid flat plate collector are

1. The absorber plate
2. The tubes fixed to the absorber plate
3. The transparent cover
4. The collector box

The main advantage of a flat plate collector is that it utilizes both the beam and diffuse components of the solar radiation. In addition, because of its simple stationary design, it requires little maintenance. The liquid heated is generally water. However, sometimes mixtures of water and ethylene glycol are used if ambient temperature is below 0°C are likely to be encountered

Gas geyser

The Gas geyser here we are using is tank less gas geyser. Tankless gas geyser also called instantaneous, continuous flow, inline, flash, on-demand, or instant-on water heaters are gaining in popularity. These high-power water heaters

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instantly heat water as it flows through the device, and do not retain any water internally except for what is in the heat exchanger coil. Copper heat exchangers are preferred in these units because of their high thermal conductivity and ease of fabrication.

Electrical heater coil

A heating element converts electricity into heat through the process of Joule heating. Electric current through the element encounters resistance, resulting in heating of the element. Copper heat exchangers are preferred in these units because of their high thermal conductivity and ease of fabrication. The heat exchange takes place between the heated copper coil and cold water which is stored. The advantage of using electrical energy at a relatively slow rate, storing the heat for later use.

Working principle

The over head tank is placed at the top most level that is on the roof of any building .the cold water are stored in the over head tank .the water from the tank is made to flow through the pipe and get collected in the storage tank of the solar flat plate collector. The water is drawn into the collector tubes. The collector tubes are usually made of copper. The radiations are directly made to fall on to the absorber plate. The absorber plate absorbs the radiation from the sun and then transfers the heat to the collector tubes. By the process of convection the water gets heated up and tends to move upwards. The above working is due to the thermosyphon principle

IV. EXPERIMENTAL RESULTS

By the thermosyphon principle the hot water settles at the top and the cold water settles at the bottom and the continuous process of heating of the water takes place until all the water gets heated up. The temperature of the water can be measured by the digital temperature indicator.



Fig. 2. Proposed Model of Hybrid Water Heating System

If the water is not heated up due to the low radiations falling on it then the cold water stored in the collector tank can be heated up by electrical heater coil. The electrical heater coil heats up the water which is made to flow through the exit pipe. This is not an instantaneous process and takes a longer time when compared to other two equipments.

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Observation results

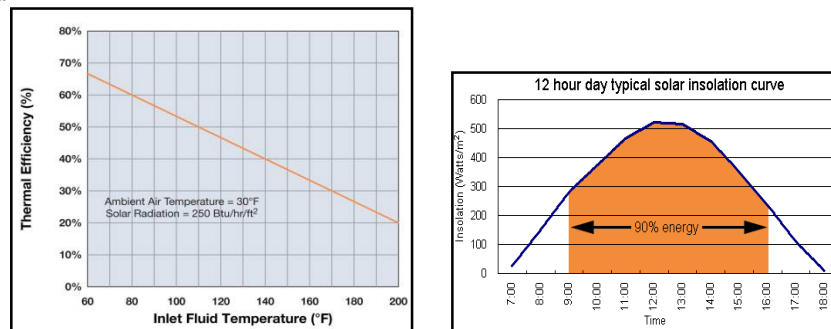
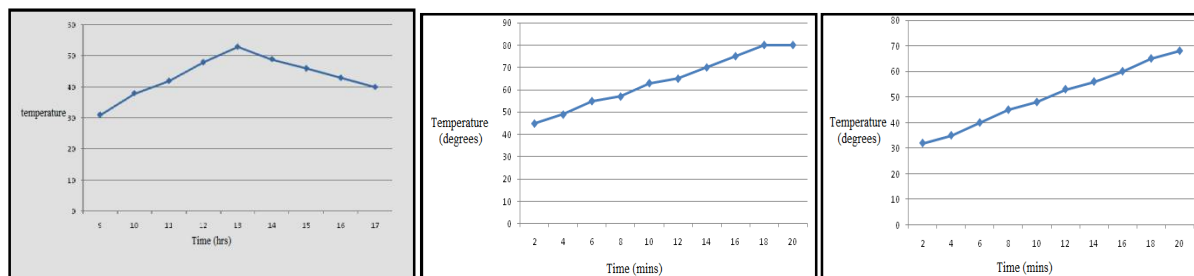


Fig. 3 a) Inlet Fluid Temperature V/S Thermal Efficiency b) 12 hour day typical solar insolation curve



c) Temperature V/S Time Plot d) Temperature V/S Time Plot of Gas Geyser e) Temperature V/S Time Plot of Electrical Heater

If there is no electricity then we can heat up the water by using a third system named gas geyser. The water enters in the inlet pipe and hot water comes out of the exit. This is an instantaneous and continuous process of heating. The water can be heated to the desired temperature by adjusting the knobs of flame. Based on the season the water can be heated up. There is a separate provision for different season. The water coming out of the exit pipe can be measured .finally we can obtain the desired temperature at the exit by any of the three equipments.

V. CONCLUSION

The Hybrid Water heating system can be used effectively in almost all the season that is throughout the year. The damage caused to one system does not affect the other two equipments. The proposed model is economical compared to other equipments available in the market. The primary importance given to the SFPC reduces the operating cost, that is solar energy which is available at free of cost and also abundant in nature is utilized more. The collector storage tank size is reduced in order to increase the efficiency of the electrical heater coil. It is eco-friendly. The maintenance of the entire system is less compared to other system.

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