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ENHANCING THE PRODUCTIVITY OF THE SOLAR WATER HEATER WITH VARIOUS ENERGY STORAGE MATERIAL

[1]A. Senthil Rajan, [2]L.Rajeshkhanna, [3]V. Vinoth
[1]Department of Mechanical Engineering, Mohamed Sathak polytechnic, Kilakarai-623806, Tamil Nadu, India.
[2]Department of Marine Engineering, Mohamed Sathak polytechnic, Kilakarai-623806, Tamil Nadu, India.
[3]Department of Marine Engineering, Mohamed Sathak polytechnic, Kilakarai-623806, Tamil Nadu, India

***Abstract*— Climatic conditions will not be the same through the year. During the summer as the temperature increases the level of water from water resources' such as ponds, well, river Decreases. People of various parts of the country suffer from scarcity of water. The main objective of this study is to design a suitable water heater operated in solar mode and electric mode with PCM. The maximum outlet temperature was 53^0C. The maximum efficiency was 44% in solar mode. Inclusion of PCM increases the efficiency**

Keywords— **water heater, pcm, solar mode**

I. INTRODUCTION

Renewable energies are one of the most trending topics and methods for generating electricity and energy in general used varied in different places and domains. Morocco has also adopted to this new technology for years now. One of the motives behind this is that the CO2 emissions in the last few years has grown since morocco is still developing as a country in the industrial field. The aim and main objective of the project is to build a cost-efficient solar water heater (SWH) for the purpose of using it in the model house that was chosen randomly for renovation, which itself will be as a motivation for the villagers to consider doing such renovation for their houses.

II. LITERATURE REVIEW

Ahmet Samanci [1] found that the efficiency of the closed system is lower than the two phase system and also by using two phase SWHS heat is transferred by the process of evaporation & condensation as a result of quick response to change in solar radiation. Sanjay Kumar Sharma et al [2] suggested that the system is designed for 5 liters water inside & outside of the tank for per hour and 30 liters water capacity tank. The research work focuses upon the process of energy conversion from the collector to the working fluid. This is accomplished by employing an aluminum sheet placed at the base within the system to induce a gradient of heat capacitance and the Flat Plate Collectors (FPC) and Evacuated Tube Collectors (ETC) are more popular devices used in the solar water heater system. This domestic V- Through flat plat collector system with a capacity of 100 liters per day is capable of achieving significant energy savings in hot climate countries. Particularly, in the present situation of acute energy short age and most suitable to supply the needs as a family of four persons. The evacuated tube collector method is more popular in the last decade which has a great impact in the solar water heater industry. There are more manufactures and suppliers for the Evacuated Tube Collectors because of this there is greater expansion in the solar water heating businesses. Due to this the cost of manufacturing came down which resulted in reduction in costs of the domestic solar water heater systems. Rajakrishnamoorthy P [3] suggested that the efficiency of the conventional collector is lesser when compared to the Integrated collector storage solar. Pankaj Kumar Mongre [4] suggested that increase in the instantaneous efficiency 55.24 % due to increase in glazing area. Morrison et al [5] has identified that during high temperature operations the evacuated tube solar collectors has a good performance than the flat plate collector. The U-tube glass evacuated solar collector is being used widely when compared to a heat pipe method. Some experimental investigation has resulted that U tube welded inside a circular fin has a good result in thermal efficiency, which has a benefit over other different shapes of the absorber tube. The parts which are used for the fabrication of this evacuated U tube solar water heater are discussed in the components and description section. The aim and main objective of the project is to build a cost-efficient solar water heater (SWH) for the purpose of using it in the model house that was chosen randomly for renovation, which itself will be as a motivation for the villagers to consider doing such renovation for their houses. The solar water heater is operated in both solar mode and with and without the inclusion of PCM. The solar mode was also cut off and the heater is operated in electric mode.

III. THE BUILDING OF THE SWH

Collector Housing (Made of iron) Length: 2000 mm width: 1000m height: 100mm Insulation Length:1960mm width: 960mm height: 50mm Copper Tubes Length: 6000mm Diameter:38 mm 26 Glazing Length:1960mm width: 960mm

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height: 6mmThe copper tubes will circulate the water inside the collector and absorb the sun rays and turn them into useful heat for water. To increase the absorption rate of the copper tubes, they will be painted in black because black color has high absorption of sun rays. The copper tubes will be bended and reformed as a serpentine inside the collector. The final part is the glazing of the collector which is the cover glass that will cover the flat plate collector and protect the system form rain or snow. The type of glass to be used is the toughened glass of a thickness of 6 mm.

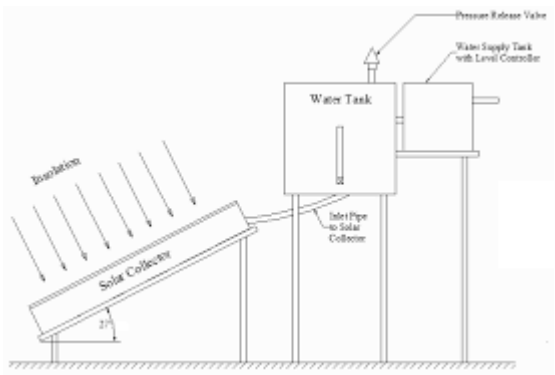

Fig.1 Experimental setup

IV. OPERATION

The solar water heater consists of flat plate collector with copper tubes fitted on them. The water is allowed through these copper tubes the flat plate receives the solar radiation from sun which is used for heating the water. The water is initially allowed at room temperature, after absorbing solar radiation the temperature of water raises. The water is collected in the collecting tank and used for commercial purposes. The glass cover attached at the top receives solar energy. The entire setup is paced in the air tight container with suitable insulation to avoid heat loss to the surrounding. The phase change materials were introduced in the still to store excess heat and supplies this heat to the water whenever required. The still was tested by cutting solar mode and supplying electric current through the heater.Fig.1 shows the experimental setup

Calculation of collector efficiency (complete cycle)

The efficiency of the SWH is calculated for the trial-1 for the given period of heating time Total duration of heating = 100 minutes ΔT achieved = (50-34) = 16°C

Mass of water = 25 kg

Cp of water = 4187 J/kg°C

Q heater= m*Cp = 1674.8 KJ

Wattage heater= Q/t = 279 Watts

Average solar power in India is 5 KW/meter^2

Surface area of the collector = 0.3542 meter^2

So net solar power incident on collector surface = [5 * 0.3542 * cos 30°] {Cos 30° gives the projection of the collector on the ground, as it is tilted at an angle of 30° with the horizontal surface}

So Efficiency of the collector = [W heater/W solar] * 100 = 18.19 %

V. RESULTS AND DISCUSSIONS

I. EFFECT OF SOLAR RADIATION

The Fig.2 shows the effect of solar radiation on outlet temperature. The solar radiation was minimum at the starting after that it increases and reaches the peak at noon after that it falls again. The outlet temperature also increases when solar radiation increases and reaches peak at 1042 w/m^2.

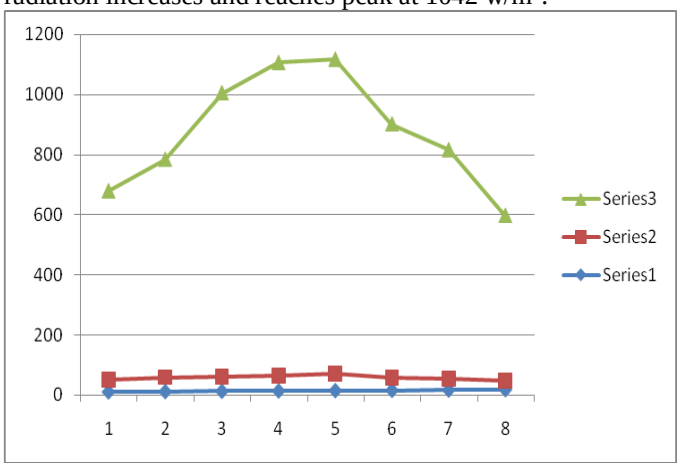

Fig.2 EFFECT OF SOLAR RADIATION

2. EFFECT OF SOLAR MODE

The Fig.3 shows the output of outlet temperature, efficiency and solar radiation in solar mode without PCM. The outlet temperature, efficiency depends on the amount of solar power received by the collector. It was noticed that the outlet was maximum at noon (1042w/m2) the maximum efficiency noticed was 44%

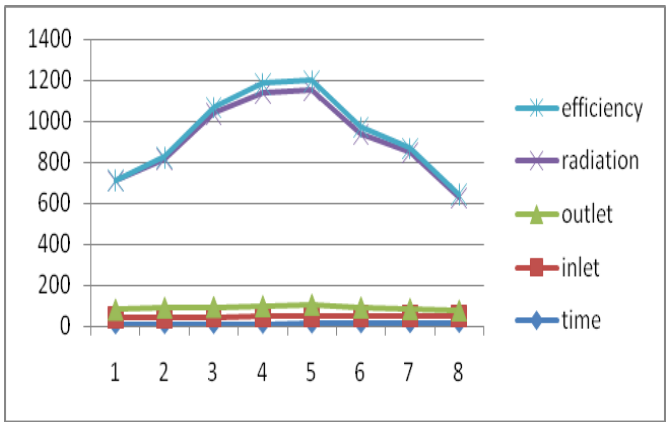

Fig.3 EFFECT OF SOLAR MODE

3.EFFECT OF SOLAR MODE WITH PCM

The Fig.4 shows the output of outlet temperature, efficiency and solar radiation in solar mode with PCM. The outlet temperature, efficiency depends on the amount of solar power received by the collector. It was noticed that the outlet was

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maximum at noon (1042w/m^2) the maximum efficiency noticed was 58% due to the addition of energy storing materials in the still.

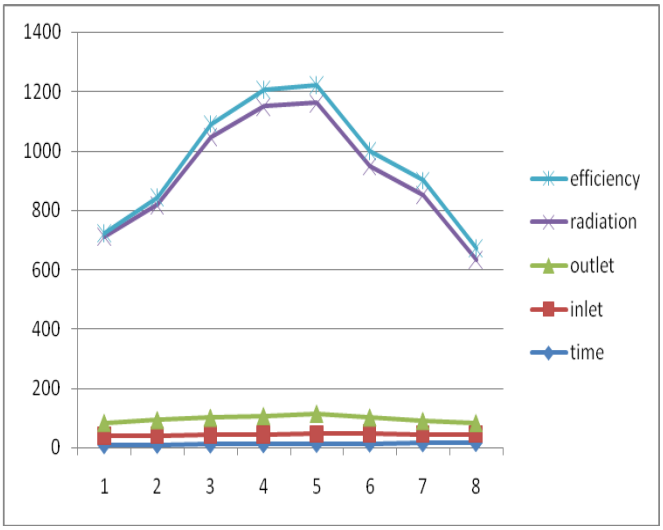

Fig.4 EFFECT OF SOLAR MODE WITH PCM

4. EFFECT OF ELECTRIC HEATER MODE

The Fig.5 shows the output of outlet temperature, efficiency and solar radiation in electric mode. The outlet temperature, efficiency depends on the amount of solar power received by the collector. It was noticed that the outlet was maximum at same amount of current equal to solar radiation (1042w/m^2) the maximum efficiency noticed was 54%.The cost of production was very high when compared to solar modes.

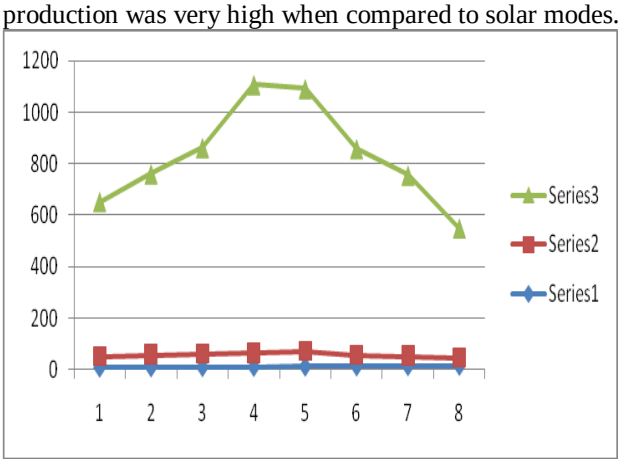

Fig.5 EFFECT OF ELECTRIC HEATER MODE

VI. CONCLUSION

As a results of the above study the following observations were noted

- The outlet temperature depends on the amount of solar radiation received by collector
- The outlet temperature and efficiency were maximum at noon in solar mode
- The maximum outlet temperature was 53^{0}C
- The maximum efficiency was 44% in solar mode
- Inclusion of PCM increases the efficiency
- The still can be operated in electric heater the cost of operation was high

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