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THERMAL ANALYSIS OF TRIANGULAR EMBOSSED ABSORBER PLATE WITH THERMAL STORAGE SYSTEM

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Abstract: The sun has been a powerful presence and force throughout the history of human existence on earth. Many cultures considered it a god in one form or another, and most understood it as the ultimate source of life on this planet. Solar energy is one of the simplest and easiest renewable energy sources to use. A solar water heater uses solar energy to produce heat (not electricity), which can then be used to heat water for showers, space heating, industrial processes or even solar power. The purpose of this work is to manufacture a solar water heating system using wax as a heat storage medium and give triangular shapes to the damping plate to improve the radiation network and evaluate the thermal efficiency of the same solar water heater.

***Index Terms* – Solar Water Heater, Embossed Absorber Plate, Wax and Solar Energy.**

I. INTRODUCTION

The sun is the soul of everything on earth. As society evolves, it uses energy in different forms at each stage. Energy consumption per capita determines the level of development of the country. From this follows the more general statement that the higher the energy consumption per capita, the more developed the country. There are various sources of energy that can be classified as conventional and non-conventional sources. A solar water heater consists of a collector to collect solar energy and an insulated storage tank to store hot water. Solar energy hitting the absorption panel covered with the selected coating transfers the hat to the uprights below the absorption panel. The water passing through the risers is heated and fed into the storage tank. Circulating the same water through the absorption panel in the collector raises the temperature to 80 0C (Maximum) on a good sunny day. The entire system, including the solar collector, storage tank and piping, is called a solar hot water system. Generally, solar heating systems fall into two categories. They are: closed loop system and open loop system. Heat exchangers are installed in the first, which protect the system from hard water in boreholes or frost in cold places. In the second type, either thermosiphon or forced circulation system, the water in the system is sometimes exposed to the atmosphere. Hashim et al.[1] focused on the main solar thermal usage scenarios in Iraq using solar water heating (SWH) in a flat plate collector. Ogueke et al. [2] reviewed different designs of solar water heaters and compared their performance. Zhang et al.[3] focused on a comparative study of the annual performance of the eye thermosiphon SWHS and conventional SWHST. HO C & Chen T ET AL. [4] studied the collection efficiency of dual-circulation plate and tube solar water heaters with tube wall-mounted internal fins and external recirculation. Chittireddy et al. [5] An AC cooled flat panel solar collector tested as a cooling element for a water heater with dense corrugated fins attached to the tubes. Kalogirou [6] investigated different types of solar collectors and their applications. According to Al-Madan [7], thermal efficiency was fully evaluated in March and April. Sivakumar et al.[8] performed experiments with an elliptical heat pipe solar collector designed, fabricated and tested for various mass flow rates and Lc/Le ratios.Mazarrón F R et al. [9] tested the feasibility of water heating with evacuated tube collectors at different operating temperatures. Ogie et al. [10] analyzed the design and construction of a HUW where water is heated and flows through a tank as a coolant. Rushi Prasad et al. [7] compared the performance of a fixed flat water heater with a delayed water heater by conducting experiments. Herrero Martin et al. [8] developed an experimental test for side-by-side solar panels according to the requirements of EN12975-2. Parent et al. [9] investigated the behavior of HX liners and tubes outside a storage tank where the fluid flow was induced by natural convection. Smith et al. [10] tested a twisted strip inserted into a pipe to generate turbulent flow. Shahidul Potthuru R P et al [11] INCLUDES Experiments were conducted for a week WHERE data was collected both for fixed and tracked conditions of the flat plate collector.. Selvam S et al [12] focused on the performance factor of an integrated solar water heating system used for hot water production in domestic and industrial applications. P.P.Patil et al [13] focused on the design of solar water heaters for domestic and industrial use. Chii-Dong Ho et al [14] investigated and theoretically studied a double membrane and tube solar water heater with internal fins attached to the tube walls from the inside. L. Chilambarasan et al [15] worked on solar panel collectors with helical internal slots to improve their conversion efficiency by reducing heat loss from the collector surface. Herrero Martin et al. [16] developed an experimental test for side-by-side solar panels according to the requirements of EN12975-2. Taherian H et al. [17] his work studies the dynamic simulation of thermosyphon solar water heater collector considering the weather conditions of a city in north of Iran. Smith et al. [18] tested a twisted strip inserted into a pipe to generate a turbulent flow. Shahidul Islam Khan et al.[19] collected annual data on the performance of SWH with a volume of 100 L and 200 L. Sushil Tiwari et al. [20] reviewed the methods proposed by various researchers to increase the efficiency of a solar water heater. Ho et al. [21] performed an experimental and theoretical analysis on a circulating planar solar water heater equipped with rectangular channels. D. Prakasz et al. [22] focused on the efficient use of solar energy with a new solar water heating system where the heat flow in the internal structure is interrupted by a suitable roof insulation material.S. Sadishkumar et al. to [23] started research on the possibility of using phase change materials (PCM) to store solar energy and use that energy to heat water for domestic use at night. Ankit S Gujrathi et al. [24] tried to use Ansys 15.0 Workbench software to model a parabolic collector and the PTC was designed for a concentration factor of 25. Soteris A. Kalogirou [25] presented a study on different types of solar collectors and their applications. Samara Sadrin and others [26] focused on the replacement method for solar water heating systems. P. Rhushi Prasad et al. [27] investigated the experimental analysis of a flat plate collector and compared the performance with a tracking receiver. Wattana Ratismith et al [28] described a passive collector design where the outlet temperature is increased reducing heat losses. Krisztina Uzuneanu et al. [29] described the optimal tilt angle for low-concentration solar collectors. R. Herrero et al. [30] Concentrated enhancement technology for flat liquid solar collectors. Mustafa Aktas et al [31] obtained an experimental analysis of the optimal fin size used in heat exchangers of the solar system. K. Sivakumar et al. [32] designed and tested a flat elliptical heat pipe solar collector with an inclination angle of 11° to the horizontal plane. Kalogirou [33] worked on a comparison of the total thermal efficiency of a photovoltaic water heater. Madani et al. [34] discusses the search entitled Residential Heating Options in China: Contemporary Reputation and Future Prospects. Souliotis et al. [35] carried out a search for photovoltaic water heating in social housing: capacity assessment and life cycle assessment. [36-52] Patel Anand et al. documents series of studies involving geometric parameters variation of the absorber plates in solar air/water heater and solar cooker. The studies from [53-60] involves optimization of design in parabolic trough in solar energy application systems. [61-72] studies involves an optimization and comparative analysis of different compact plate-fin type structures, constituting the receiver’s absorber panels, classified according to the type of fin arrangement insid

II. EXPERIMENTAL SETUP

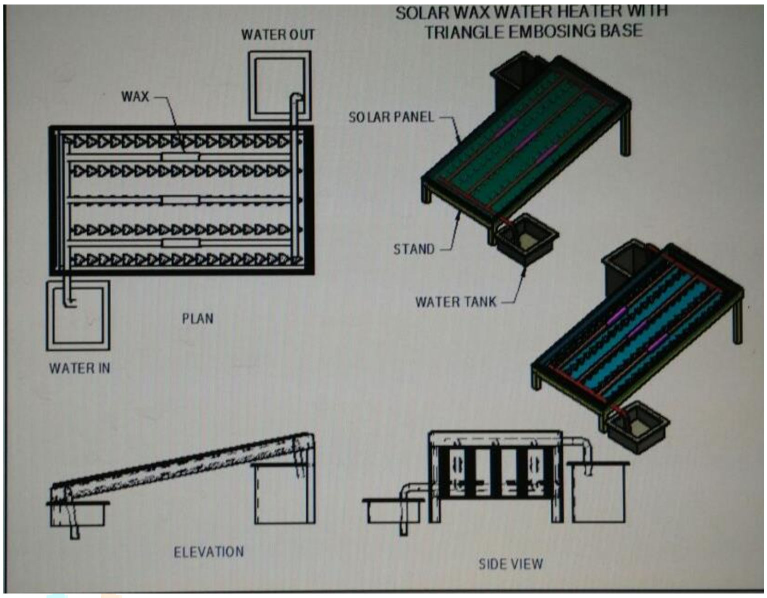

Fig 1 CAD Model of Experimental Set up

Figure 2 Experimental Set up

Figure 3 Triangular Embossed

Figure 4 Water Supplying Tank

Figure 4 Thermocouples

In this experimental set up ½" diameter three copper tubes of 1m length are fabricated using brazing process with ½" diameter two copper of 0.5 m at top and bottom and whole assembly is kept in wooden box 1.1 m X 0.6 m X 0.05 m and box is covered from 0.5 mm thick triangular embossed shape at bottom and 2 mm glass sheet at top. 0.5 m copper pipes are connected to PVC pipes through with water enters and exits from solar water heater and measuring flask and K type thermocouple are used for flow measurement and temperature measurement. All three copper tube consist of wax box of 8" length and ½" diameter.

III. RESULT AND DISCUSSION

Table 1 Result Table

Type	Shape	Time	Inlet Temperature(^{0}C)	Inlet Temperature(^{0}C)	Mass Flow Rate Time (min)
with Wax	Triangle	11:30	28	39.3	1.47
		11:45	28	42.1	1.47
		12:00	28	50	1.47
without Wax		11:30	28	42.8	1.47
		11:45	28	47.6	1.47
		12:00	28	47.8	1.47

In the present work two major modifications are made in experimental set up and which are responsible in heat transfer enhancement ant which ultimately leads to rise in temperature of water. The emboss plate store solar energy and behaves like energy source and second parameter is wax box which absorbed partly incident heat and due to melting of wax presence in wax box melted and which play an important role in temperature rise. Table 1 indicates results obtain with and without wax the outlet temperature values of solar water heater.

IV. CONCLUSION

The thermal storage system plays a vital role in performance of solar water heater and due emboss absorber plate also there is appreciable rise in heat transfer rate.

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