A Review: DESIGN AND DEVELOPMENT OF CORRUGATED PLATE SOLAR STORAGE/COLLECTOR TYPE OF WATER HEATER

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ABSTRACT

Nowadays, water heating by using the solar energy has been spread all over the world. The studies on solar water heating system were stimulated the researchers due to the scarcity of natural energy resources, like fossil fuel and natural gas as well as the rising and rapidly fluctuating prices for these resources.
The purpose of this study is to design and manufacture a new storage domestic water heater with solar collector. In this project integrated solar/collector type of water heater is designed, the flat absorber plate is replaced by corrugated shaped absorber plate. The corrugated shaped absorber plate will enhance the rate of heat transfer between the plate and water in contact. The proposed corrugated plate collector is designed and fabricated by local available materials. In present work 105L of the collector is designed and developed the plate area designed is about 1.5m^2
Moreover, in the present work a simple CFD model of the proposed design of the corrugated plate collector is presented which includes all the modes of heat transfer convection, conduction and radiation from the glass cover, absorber plate water and bottom of the flat plate collector. For the sake of simplicity, the side losses from the collector is not considered the heat capacity of the glass cover and the absorber plate.

Keyword : - *radiation, convection and integrated collector storage system,*

1. INTRODUCTION

In recent years solar energy has been strongly promoted as a viable energy source. One of the simplest and most direct applications of this energy is the conversion of solar radiation into heat. Solar energy is recognized as one of the most promising alternative energy options. On sunny days, solar energy systems generally collect more energy than necessary for direct use. Therefore, the design and development of solar energy storage systems, is of vital importance and nowadays one of the greatest efforts in solar research. These systems, being part of a complete solar installation, provide an optimum tuning between heat demand and heat supply. Hence way that the domestic sector can lessen its impact on the environment is by the installation of solar flat plate collectors for heating water.

A Solar Water Heating System (SWHS) is a device that makes the available thermal energy of the incident solar radiation for use in various applications by heating the water. Hot water is essential both in industries and domestic applications. It is required for taking baths, washing clothes and utensils, and other domestic purposes in both the urban and rural areas. Hot water is also required in large quantities in hotels, hospitals, hostels, and industries such as textile, paper and food processing, dairy, and edible oil. The SWHS consists of solar thermal collectors, water tanks, interconnecting pipelines, and the water, which gets circulated in the system. Fig. 1 illustrates the typical thermosyphon solar water heating system. Solar radiation incident on the collector heats up the tubes, thereby transferring the heat energy to water flowing through it. In brief, solar energy incident on the flat-plate collector is absorbed by the black-chrome coated copper plate and thereby heats the water in the riser tubes which circulates due to density difference, i.e. the thermosyphon effect. Solar Water Heating systems are grouped into two broad categories as passive and active solar water heating systems.

The passive solar water heating systems generally transfer heat by natural circulation as a result of buoyancy due to temperature difference between two regimes; hence they do not require pumps to operate. They are the most commonly used solar water heating systems for domestic application. Active solar water heating systems have electric pumps, valves, and controllers to circulate water or other heat-transfer fluids through the collectors.

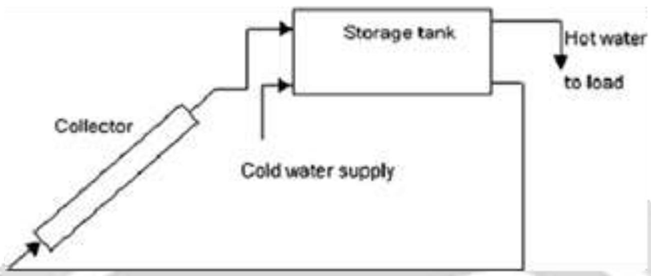

Fig.1. Thermosyphon solar water heater

2. CORRUGATED PLATE SOLAR WATER HEATER

It is type of solar absorber plate. The corrugated absorber plate is painted black. In this system we will use material of mild steel material for corrugated absorber plate, absorber glass and glass wool for insulated cover. The show in fig. 2

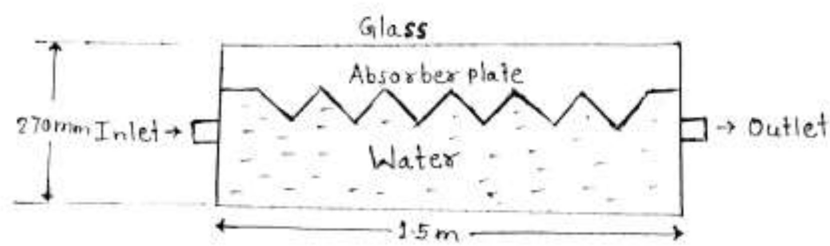

Fig 2 corrugated solar water heater

3. SUMMERY OF THE PREVIOUS PAPER

Jaji Varghese,gajanan K.Awari and Mahendra P. Singh[1] developed a new design of solar water heater. In this system, the collector and storage were installed in one unit. Unlike the conventional design consisting of small diameter water tubes, it has a single large diameter drum which serve the dual purpose of absorber tube and storage tank. In this principle it is a compound parabolic collector. The drum is sized to have a storage capacity of 100 liter to serve a family of four persons.

C. Dharuman ,J.H.Arakeri, K. Srinivasan[2] describes the design, construction and performance test results of one such water-heating device. The test unit has an absorber area of 1.3 m^2 and can hold 170 L of water, of which extractable volume per day is 100 L. Its performance was evaluated under various typical operating conditions. Every morning at about 7:00 a.m., 100 L of hot water were drawn from the sump and replaced with cold water from the mains. Although, during most of the days, the peak temperatures of water obtained are between 50 and 60 8C, the next morning temperatures were lower at 45–50 8C. Daytime collection efficiencies of about 60% and overall efficiencies of about 40% were obtained. Tests were conducted with and without stratification. Night radiation losses were reduced by use of a screen insulation.

M.S. Sodha, P.K.Bansal and S.C.Kaushik[3] give a simple transient model for predicting the thermal performance of some novel solar water heaters which combine both collection and storage of solar energy. These heaters consist of either (i) an insulated rectangular tank whose top surface is blackened and suitably glazed, or (ii) an insulated open shallow tank with black bottom/inner sides and a top glass cover (shallow solar pond). The heaters are adequately covered with an insulation during the night to reduce the heat losses. The proposed model is based on different characteristic equations during sunshine and off-sunshine hours. It is seen that the model predicts the water temperature in close agreement with the experimental observations and earlier theoretical investigations.

Alexios Papadimitratosa, Sarvenaz Sobhan sarbandib, Vladimir Pozdina,Anvar Zakhidov c,d, Fateme Hassanipour[4] This paper presents a novel method of integrating phase change materials (PCMs) within the evacuated solar tube collectors for solar water heaters (SWHs). In this method, the heat pipe is immersed inside the phase change material, where heat is effectively accumulated and stored for an extended period of time due to thermal insulation of evacuated tubes. The benefit of this method includes improved functionality by delayed release of heat, thus providing hot water during the hours of high demand or when solar intensity is insufficient. The proposed solar collector utilizes two distinct phase change materials (dual-PCM), namely Tritriacontane and Erythritol, with melting temperatures of 72 degree C and 118 degree C respectively. The operation of solar water heater with the proposed solar collector is investigated during both normal and on-demand operation. The feasibility of this technology is also tested via large scale commercial solar water heaters. Beyond the improved functionality for solar water heater systems, the results from this study show efficiency improvement of 26% for the normal operation and 66% for the stagnation mode, compared with standard solar water heaters that lack phase change materials.

4. REVIEW WORK ON CORRUGATED SOLAR WATER HEATER

Jaji Varghese,gajanan K.Awari and Mahendra P. Singh[1] The experimental investigation of BSWH systems revealed that the maximum operating efficiency is achieved with two glass cover (BSWH-2) system. The maximum mean daily efficiency obtained is 37.2% during 3 to 4 p. m. To achieve the maximum system performance water utility pattern should be such that maximum water is consumed before noon hours. The design is competent to deliver warm water even the next morning.

C. Dharuman,J.H. Arakeri, K. Srinivasan [2] The present model of the integrated solar water heater can supply 100 l of hot water at 45–50 8C in the early morning, which is quite adequate for bathing and cleaning in the domestic sector. Higher water temperatures are obtained during daytime, which could be gainfully exploited in the industrial and hospitality sectors. It is simple in design and is estimated to be 30% less expensive compared to conventional flat plate collectors of equivalent storage capacity. However, it appears that the screen insulation during night time and mixing to remove stratification only marginally improved the performance of collector. There was no tangible effect of the material of screen insulation. The overall heat loss coefficient between absorber and ambient is between 3 and 5 W/K.

M.S. Sodha, P.K.Bansal and S.C. Kaushik[3] To have a numerical appreciation of and to validate the proposed simple model for predicting the transient performance of collector/storage solar water heaters, we have made calculations (assuming the top insulation to be of the same thickness as that of bottom insulation) for the following set of parameters, corresponding to those in the experiments and rigorous calculations of Sodha et al.

Alexios Papadimitratosa, Sarvenaz Sobhan sarbandib,Vladimir Pozdina,Anvar Zakhidov c,d, Fateme Hassanipour[4] This paper presents the performance of a solar water heater with evacuated tubes integrated with phase change materials. The results show that phase change material integrated inside the inner tubes of evacuated tube solar collectors can effectively store energy (in the form of latent heat) next to the heat pipes and enable a delayed cooling after sunset or late evening. The proposed solar collector utilizes two distinct phase change materials (dual-PCM),namely Tritriacontane and Erythritol with melting temperature 72 C and 118 C respectively. The operation of solar water heater with the proposed solar collector is investigated during both normal and on-demand operation. The feasibility of this technology is tested via large scale commercial solar water heaters. This study shows a significant efficiency improvement of dual-PCM solar water heaters for both normal and stagnation operation, compared with standard solar water heaters that lack phase change materials.

5. CONCLUSION

In this objective of the research work is to improve the efficiency of corrugated solar water heater system and cover all possibility for improving efficiency and minimum cost in this system

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