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Study Of Domestic Solar Water Heaters With Different Designs: A Review

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Abstract- In this review paper, their applications were discussed on the current solar water heating systems. Today, a day is spent on hot water for home, business and industry. Different resources such as coal, diesel, gas, etc. for heating water and sometimes steam production are used. The main alternative to the replacement of conventional energy sources is solar energy. The solar thermal water heating system is the technology to make the most of the free solar thermal energy available. The solar thermal system is designed to satisfy the energy requirements. System size depends on solar radiation availability, customer temperature requirement, geographical conditions and solar system set-up, etc. The solar water heating system according to the above parameters must therefore be designed. To understand construction, design, use and size of the solar thermal system, the available literature is reviewed.

I. INTRODUCTION

In the history of human existence on earth, the sun was a powerful presence and power. Many cultures have seen it as a god of some form and have mostly understood it as the ultimate source of life on this planet. During the centuries it was also deliberately exploited by many clever ways to make better use of this energy that gives life. The sun is the best and most stable we have when it comes to renewable sources of energy. It is infinitely powerful, understandable, and predictable in all practical timeframes, in its global tendencies and patterns, and beyond anthropogenic effects for a foreseeable future. In brief, the perfect source of energy, but it's no problem.

Solar heater is a device for hot water production by using solar energy to produce steam for domestic and industrial uses.Solar heating is a device that is used to heat the water and to generate steam using solar energy for domestic and industrial purposes. The solar energy comes from the sun in infinitely large quantities in the form of solar radiation. This heat is used to heat the water when these solar radiations fall on the absorbing surface and are converted into heat. This type of thermal collector is subject to radiation and convection heat loss. These losses rise rapidly as the working fluid temperature increases.

II. SOLAR COLLECTORS

The main component of solar active heating systems are solar collectors. We absorb energy from the sun, turn it into heat, and then transfer it into the working fluid (usually water or air). Solar thermal energy in photovoltaic, solar piscine heaters and solar space heating systems can be used. These designs are classified as solar collector in two general types:

a. The absorbing layer is approximately as large as the collector's entire area, which intercepts the rays of the sun.
b. Large areas of mirrors or lenses focuses on a smaller absorber in the sunlight.

III. SOLAR WATER HEATER

Solar water heating systems are normally very easy to use with heat water only with sunlight. A working liquid touches a dark surface exposed to the sun which increases the fluid temperature. The fluid can be directly heated water or a heat transfer fluid such as a glycol / water mixture passing through a form of heat exchangers known as an indirect system.

There are a number of major components in a solar water heating system (SWHS), one or more panels, pump, heat exchanger, a storage tank (or various storage tanks) and a storage back-up tank. Possibly passive or active solar heating is considered. Usual practice is for water heating purposes to use flat-plate solar energy collectors (FPCs). While the ETC and the ETHP (Evacuated Tube Pipe Pipes) are more effective, the original price is comparatively greater. The original price is more effective than that.

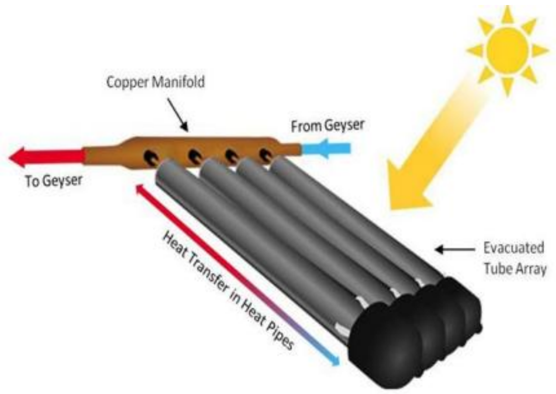

Figure: schematic view of solar water heater (vasan wala et. al. 2017)

IV. SOLAR ENERGY COLLECTORS

Solar energy collectors operate in similar ways with heat exchangers by transforming one type of energy into another form of solar radiation in the form of hot water. A solar collector is the component that enables this energy exchange. The solar collector absorbs and transforms radiation into heat. The energy is then converted through the collector to a liquid, normally water or a Glycol combination. The energy obtained from the mentioned process is then transferred directly from the fluid to where it is necessary, or to the solar water heating tank, which can be used if required. The mounting of solar collectors is possible in two ways; stationary or tracking. The measurement is carried out at the design stage to ensure an acceptable inclination of the panels for location and use in the installation of the collector in a stationary position. The collectors are then set to this inclination angle throughout the year and for the life of the system.

V.LITERATURE REVIEW

Different studies in the field of solar hot water systems, including in the past and present, natural and forced mode of circulation. solar hot water system performance in solar water heater design can be improved. Previous studies of literature are discussed here.

Abdellah Shafieian et. Al. (2019) This study evaluates the performance of a solar water heating system for heating the hot water heat in Perth (West Australia) during a cold day in theoretical and experimental terms. An optimum number of glass tubes of the solar heat pipe collector has been developed and used for calculating the mathematical model. Studies have shown that hot water extraction has a major impact on solar water heating systems ' thermal quality, by increasing the absorption and overall efficiency and reducing exergy destruction. This shows the importance of the design and analysis of these systems taking into account the pattern of heat water consumption. The auxiliary heating element constituted a required part of the system and played an important role in the early morning of the operation (19 minutes of operation) and in the cloudy and overcast time, in part.

D Prakash et. al. (2018) This work focuses on the efficient utilization of solar energy by means of a new solar water system, and adequate ceiling insulation material stop the flow of heat within the indoor construction. The changed solar water heater insulation ceiling is intended to be simulated numerically and validated in commercial dynamics software computation fluids. The research analyses the variables that affect the efficiency and thermal insulation of Solar Water Heating Scheme and the optimum design of the adapted ceilings. The updated roof system generates 25 liters of hot water per day with a rise in the summer temperature of 60 ° C. The same roof structure also sets the roof temperature at approximately 27 ° C for a day in summer.

S. Sadhish kumar et. al. (2018) This study examined the probability of the use of Phase Change Materials for the store and use of solar energy during the night for domestic water heating. In this work the efficient use of three (i.e.) methods with no reflective, reflecting, and cum reflectant PCM (Paraffin Wax) for an enclosed liquid-in-glass solar water heater has been investigated. Factors affecting the efficiency of tube pipe evacuation will be analyzed and a numerical analysis will be given of the water circulation in the tubes. The simulation findings were subsequently generated with the test results. The use of the proposed solution was found to lead to 5 °C to 7 °C advantages over long periods at the stored warm water temperature.

K. Vasudeva Karanth et. al. (2017) This research analyzes the results of the energy efficiency when the absorber system tubes select different size and shape. The CFD analysis shows that the circular cross section pipe of the collector that flattened the contact surface with that of the absorber plate significantly improves thermal performance compared to other Nusselt number settings. Numerical studies show that the variations in heat efficiency are significant while different forms and dimensions are taken into account for the solar panel pipes based upon the requirements for a clear intersection and a stable perimeter. The cross-sectional test shows that the pressure drop and absolute temperature rise across the tube are comparably high for the construction of triangular pipes.

Mohammed Abdul Junaid et.al. (2017) The main aim of this study is the development and use of CAD software to carry out thermal analysises in the month of March at 11 a.m., 12 p.m. and 2 p.m. to maintain a consistent rate of mass flow. For simulation purposes is used GAMBIT 2.4 and for the analysis ANSYS FLUENT 14.5 is used. The FPC simulation is calculated from 11.00 to 2 p.m. At 12.00, the initial temperature is higher at 40.89 ° C when the temperature of the water intake is 25 ° C, so the temperature increases to 15.890 C and the output temperature decreases as time increases.

V. Y. Chaudhary et. al. (2017) The study shows how solar energy is being used by using CFD analysis which includes an evacuated tube heat pipe, which converts radiation into useful heat. The current use of nanofluids to improve heat transfer in solar thermal technology is of concern. There are two water pipes in geometry. Water and Al2O3 respectively are the working fluids used for heat pipes. The thermal efficiency of nanofluid includes the solar water heater solar tube tube is better than normal solar water heater (SWH) tubular heater. The effects on the condenser of the mass flow rate and the angle of inclination of the evacuated air pipeline results were also investigated.

M. Dinesh Babu et.al. (2016) There have been attempts to explore the effect on the efficiency of the battery of a solar water heater with fins externally attached to the riser pipe. To gain a better view of the heat exchange capacities of the collector, study the solar collector with or without computational fluid dynamics (CFD) to detect the solar collector. For finned tube obtained from CFD, the tests were confirmed by CFD and test values for plain tube and the temperature increases of 3-4 degrees C are observed for finned tube. On this basis, manufacture is carried out and experimental testing with the latest collector collection is carried out. The findings of the test indicate that the efficacy of the finned pipes instead of the basic tube is improved by around 3-5 percent.

Sukrut Surendra Prabhu (2016) The current project is performing a three-dimensional CFD study to improve solar air heater efficiency. A circular obstacle in the flow path is used in this study to improve the flow turbulence and thereby enhance the convective heat transfer to air. The numerical results are validated with experimental results for the model with and without obstacles. The results show numerically that barriers are useful for increasing the rate of heat transfer. Nevertheless, the pressure drop has increased relative to the plane template with the addition of the obstacle. By inserting fillet in the flow direction, this increased pressure drop was reduced.

Vishal G. Shelke et. al. (2015) The purpose of this analysis was to examine the effect on the flat platform solar collector of variations in tube size. This thesis considered a circular tube with a diameter of 12.7 mm and conducted numerical analysis with the program ANSYS CFD FLUENT. The temperature of the inlet and outlet for different heat streams was compared. For separate elliptical pipe forms further analyzes have been undertaken. The temperature of the liquid outlet is compared with the circulating tests. It is inferred from above that case 5 (b=0.5A) elliptical pipe provides peak outlet water temperature in contrast to the ring and other elliptical configuration for the same heat flow and inlet temperature. The maximum temperature difference between the circular and elliptical tube is also shown to be 4.17 °C.

Zaw Min Thant et. al. (2015) The following numerical work is given on the collector of water-in-glass solar tube evacuated using CFDs. An essential part of the solar-heated water heater is the evacuated water-in-glass tank. A water-in-glass collector, because its hot spring efficiency and simple construction conditions are the most widely used type of evacuated collector and therefore its low production costs. The purpose of this paper is to complement the above studies, to approach the transitional analysis of an removed tube collector using different geometries and different tube geometries, to allow better heat removal from the tube and to evaluate the behaviour, and the potential improvements to be applied in the model of this solar collector.

Jinshah Basheer Sheeba et. al. (2014) This work includes a mixed heat and structural analysis on the use of finite element techniques by the asphalt solar collector. Different models for optimum tube length, tube size, tubing deepness and tube layout were evaluated in the given situation. The statistical analysis carried out on ASC shows that both the pipe lengths and the tube length have a major impact on the temperature distribution within the ground. Within a certain threshold, structural integrity is not greatly impacted. Because ASC's structural and thermal properties vary from the current temperature situation, blending ratios and compactness of the paving, the exact results can only be predicted by means of real-time testing of large designs.

Sohel Chaudhari et. al. (2014) An effort has been made to carry out a CFD-based analysis of solar air heaters using FLUENT in fluid flow and heating. ANSYS designed the prototype of the 3D Solar Air heater with water inlet, absorber base, glass, ANSYS Workbench template and unstructured grid. ANSYS fluent code has achieved the tests. This is achieved with the use of a CFD system for flow distribution and temperature in the solar air heater. A mathematical simulation of the solar air fine heater on the ground of the absorber panel was carried out in the experiment to investigate the heat transfer and fluid friction behaviour. The influence on solar air heaters of distinct heat flow values has shown that heat flow prices increase the heat efficiency of solar air heaters.

Basavanna et. al. (2013) The object of the investigation is to examine the solar collector using the CFD to track the solar collection in order to obtain a clearer understanding of the heat transfer capacities of the collector. Fluid flow and heating transfer are currently being studied with Computational Fluid Dynamics (CFD) in the collector panel. The heat transfer event is modelled by Fluent CFD code between the collector and air. The temperature in the lower panel of the absorber is great because of the fact that this set-up tube has a larger contact area between the tube and a plate and therefore more heat absorption and more fan efficiency.

P.W. Ingle et. al. (2013) Presented numerical simulation of the solar collector provided only for drying grapes. Technically and economically highly viable is the solar drying of grapes. For current studies, CFD is used to mimic the solar collector to better understand the heat transfer potential of a computer-generated fluid dynamics instrument. ANSYS Workbench is a collector's 3D model featuring an air inlet, a wave-built absorber sheet, a winding glass wrap plate and a stem board, as well as the organized ANSYS ICEM grid. The CFD analysis shows that the air flow is not properly distributed in the solar flat panel holders. In order to resolve this issue, a fan inlet can be used to make the flat solar panel stack more powerful.

Alkhair M. Abdul Majeed et. al. (2012) Concentrate materials have been used to increase the output temperature in the water that flows inside a flat plate absorber solar water heater. In order to verify the results obtained from the numerical solution that was made using another method, simulation (modelling) technology was used. This study affected the thermal efficiency of the plate solar water heaters by increasing the temperature of the water along the length of the absorber pipe. Focusing components have been used to increase the temperature of the water floating within a single panel solar water heater absorber. To verify the effects of the numerical solution obtained using another method was used simulation (modelling) technology. This study has affected the energy efficiency of the solar water heater plate by raise the water temperature of the absorber pipe along its length.

VI.CONCLUSION

The technical basis of these installations has been studied and it is known that the design process produced has to be chosen, installed and monitored in accordance with the available sunlight and geographical conditions of the solar water heating system. A concise review was presented, mainly in terms of energy efficiency and cost effectiveness, of the design features and related technical improvements in the SWH system. Several solar water heating models have been launched and are more commonly used in developing country tropical regions. Solar collector technology, based on recent advances on thermal tubes, has been successfully developed to use solar power as a reliable source of heating for solar-adverse areas. Solar water heating by heat pipes has a lot of environmental consequences, including the existence of the cooling agent.

REFERENCES

1. Abdellah Shafieian, Mehdi Khiadani, AtaollahNosrati, "Thermal performance of an evacuated tube heat pipe solar water heating system in cold season", Applied Thermal Engineering, Elsevier, 2019.
2. D Prakash, "Thermal analysis of building roof assisted with water heater and insulation material", Indian Academy of Sciences, 2018.
3. S. Sadhishkumar, "Thermal performance of water-in-glass evacuated tube solar Collector with and without phase change material", Indian Journal Sciences, 20(2), 193-201, 2018.
4. K. Vasudeva Karanth, "CFD Analysis of a Flat Plate Solar Collector for Improvement in Thermal Performance with Geometric Treatment of Absorber Tube", International Journal of Applied Engineering Research, Volume 12, Number 14, 2017, pp. 4415-4421.
5. Mohammed Abdul Junaid, Mohammed Nazimuddin, MohdArifuddin, "Thermal Analysis of Solar Flat Plate Collector Using CFD", International Journal of Engineering Research & Technology, Vol. 6 Issue 04, April-2017.
6. V. Y. Chaudhary, Bharat Kalamkar, Prashant Patel, "CFD Analysis of Evacuated Tube Heat Pipe Solar Water Heater", International Journal of Latest Technology in Engineering, Management & Applied Science, Volume VI, Issue VS, May 2017.
7. Murtuzavasanwala, Shah yash, Virangpathak, "A Review Paper on Solar Water Heater by Evacuated Tube", International Journal of Advance Engineering and Research Development, IJAERD, 2017.
8. M. Dinesh babu, m. Venkata ramanan, "Modelling and validation of solar flat plate water heating system subjected to varying absorber geometries", International Journal Chemistry and Science, 2016.
9. Sukrut Surendra Prabhu, "Numerical and Experimental Analysis of a Solar Air Heater for Improved Performance", International Journal of Engineering Research and Development, Volume 12, Issue 3, 2016, PP.22-38.
10. Vishal G. Shelke, Chinmay V. Patil, "Analyze the Effect of Variations in Shape of Tubes for Flat Plate Solar Water Heater", International Journal of Scientific Engineering and Research (IJSER), Volume 3 Issue 4, April 2015.
11. Zaw Min Thant, MyatMyat Soe, Maw MawHtay, "Numerical Study on Temperature Distribution of Water-in-Glass Evacuated Tubes Solar Water Heater", International Journal of Engineering and Applied Sciences, Volume-2, Issue-9, September 2015.
12. Jinshah Basheer Sheeba, Ajith Krishnan Rohini, "Structural and Thermal Analysis of Asphalt Solar Collector Using Finite Element Method", Hindawi Publishing Corporation, Journal of Energy, 2014.
13. Sohel Chaudhari, Mukesh Makwana, Rajesh Choksi, "CFD Analysis of Solar Air Heater", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 6), June 2014, pp.47-50.
14. Basavanna, K S Shashishekar, "CFD Analysis of Triangular Absorber Tube of a Solar Flat Plate Collector", International journal of mechanical engineering and robotics research, Vol. 2, No. 1, January 2013.
15. P.W.Ingle, A. A. Pawar, B. D. Deshmukh, "CFD Analysis of Solar Flat Plate Collector", International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 4, April 2013.
16. Alkhair M. Abdul Majeed, M. Y. Sulaiman, K. Sopian, "Thermal Analysis of Concentrating Flat Plate Solar Water Heater Absorber Using "Ansys" Simulation, International Conference on Engineering and Built Environment, 2012.