Konark Tripathi, 2021, 9:6
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

A Review Study Of Domestic Solar Water Heaters With Several Designs

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Abstract -Their uses on existing solar water heating systems were addressed in this review article. A day is now spent providing hot water to homes, businesses, and industries. For heating water and occasionally steam generation, various resources such as coal, diesel, gas, and so on are utilized. Solar energy is the most common option to replacing traditional energy sources. The solar thermal water heating system is a technique that uses the sun's free thermal energy to heat water. The solar thermal system is intended to meet the energy needs. The size of the system is determined by solar radiation availability, client temperature requirements, geographical circumstances, and solar system configuration, among other factors. As a result, the solar water heating system must be built using the aforementioned criteria. The available literature is examined in order to comprehend the solar thermal system's construction, design, usage, and size.

Keywords- Solar water heater, Solar energy collector, storage tank, heat transfer fluid.

I.INTRODUCTION

Throughout the history of human existence on our planet, the sun has always been a powerful presence and source of energy. Many civilizations revered it as a god of some kind, with the bulk of people thinking it to be the ultimate source of life on our planet. It has also been deliberately used in a number of innovative ways over the centuries in order to make better use of the energy that supports life. When it comes to renewable energy, the sun is the most dependable and constant source we have.

There are no limitations to its power, comprehension, and predictability in all practical periods, as well as worldwide trends and patterns, and it is untouched by human impacts for the foreseeable future. Overall, it is the best source of energy, but there are no drawbacks. A solar heater is a device that uses solar energy to create steam to provide hot water for use In both domestic and industrial purposes. Solar heating is a technique that is used in both residential and industrial settings to heat water and generate steam by harnessing the power of the sun. The sun emits solar energy in the form of solar radiation, and it is generated in infinitely large quantities. When sun rays strike an absorbent surface and convert to heat, this heat is used to heat the water in the tank. Radiation and convection heat may escape from this kind of thermal collector. The rate of these losses increases rapidly as the temperature of the working fluid rises.

II.SOLAR COLLECTORS

Solar collectors are the most important part of solar active heating systems. We take in solar energy, convert it to heat, and then transmit it to the working fluid (usually water or air). Solar thermal energy may be utilised in photo voltaics, solar pool heaters, and solar space heating systems. These designs are divided into two kinds of solar collectors:

- The absorbing layer, which intercepts the sun's rays, is about the same size as the collector's total area.
- In the sunlight, a large area of reflector focuses on a small absorber.

III.SOLAR WATER HEATER

Solar water heating systems are often extremely simple to operate, using just sunshine to heat water. When a working liquid comes into contact with a dark, sun-exposed surface, the fluid temperature rises. The fluid may be directly heated water or a heat transfer fluid such as a glycol/water combination that passes through an indirect system of heat exchangers. A solar water heating system (SWHS) has many main components, including one or more panels, a pump, a heat exchanger, a storage tank (or several storage tanks), and a storage backup tank. It's possible that solar heating will be used, either passively or actively. Flat-plate solar energy collectors are often used for water heating applications (FPCs). Although the ETC and ETHP (Evacuated Tube Pipe Pipes) are more effective, their initial cost is higher. The original pricing is more cost-effective.

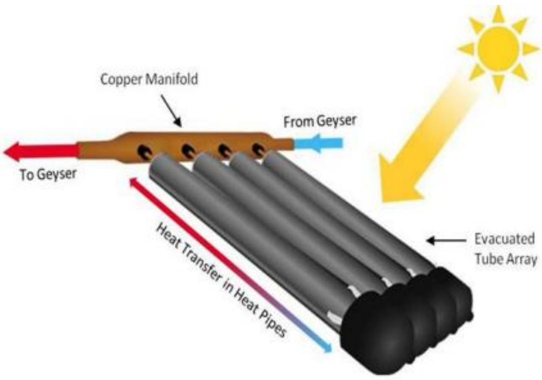

Figure1 schematic view of solar water heater (vasanwala et. al. 2017)

IV.SOLAR ENERGY COLLECTORS

Solar energy collectors work in a similar manner to heat exchangers, converting one kind of energy into another form of solar radiation, such as hot water. This energy exchange is made possible by a solar collector. The solar collector collects sunlight and converts it to heat. The energy is subsequently transformed to a liquid, usually water or a Glycol mixture, through the collection. The energy acquired from the previously stated procedure is then transmitted straight from the fluid to where it is needed, or to the solar water heating tank, which may be utilised if necessary. Solar collectors may be mounted in one of two ways: stationary or tracking. The measurement is done during the design phase to verify that the panels have an appropriate inclination for placement and usage in the stationary installation of the collector. Throughout the year and throughout the life of the system, the collectors are fixed at this inclination angle.

V.LITERATURE REVIEW

Various researches in the area of solar hot water systems, both past and current, natural and forced mode of circulation. The performance of a solar hot water system in a solar water heater design may be enhanced. Previous literature studies are addressed here.

Abdellah Shafieian et. Al. (2019) This study examines the theoretical and actual performance of a solar water heating system for heating hot water on a cold day in Perth (West Australia). A mathematical method for calculating the number of glass tubes in a solar heat pipe collector has been developed. In research, hot water extraction has been shown to enhance the thermal quality of solar water heating systems by increasing absorption and overall efficiency while reducing exergy destruction. This emphasises the need of considering the pattern of heat water consumption while developing and analysing these systems. The auxiliary heating element was a vital component of the system, and it was especially helpful in the early morning (19 minutes) and throughout the dark and cloudy time of the operation.

D Prakash et. al. (2018) This project focuses on maximising the use of solar energy via the installation of a new solar water system and the use of sufficient ceiling insulation to prevent heat from escaping the building. The modified solar water heater insulating ceiling will be numerically modelled and verified using commercial dynamics software computing fluids. The study examines the factors that influence the efficiency and thermal insulation of a Solar Water Heating System, as well as the best design of fitted ceilings. With a 60° C increase in summer temperature, the upgraded roof system produces 25 litres of hot water each day. In the summer, the same roof arrangement keeps the roof temperature at about 27 degrees Celsius.

S. Sadhishkumar et. al. (2018) This research looked at the possibility of using Phase Change Materials to store and utilise solar energy for household water heating at night. The effectiveness of three (i.e., no reflective, reflecting, and cum reflectant PCM (Paraffin Wax) techniques for an enclosed liquid-in-glass solar water heater was examined in this study. The factors influencing tube pipe evacuation efficiency will be examined, and a numerical study of water circulation in the tubes will be provided. Following that, the test results were used to produce the simulation findings. The suggested method was shown to provide 5 to 7 degrees Celsius benefits over extended periods of time at the stored warm water temperature.

K. Vasudeva Karanth et. al. (2017) The outcomes of energy efficiency when the absorber system tubes are of various size and form are examined in this study. The CFD study indicates that the collector's circular cross section pipe, which flattens the contact surface with the absorber plate, increases thermal performance considerably when compared to alternative Nusselt number settings. Based on the criteria for a clear junction and a stable perimeter, numerical calculations indicate that the differences in heat efficiency are considerable when various shapes and dimensions are taken into consideration for the solar panel pipes. The pressure drop and absolute temperature increase throughout the tube are comparable for the construction of triangle pipes, according to the cross-sectional test.

Mohammed Abdul Junaid et.al. (2017) The primary goal of this research is to create and utilise CAD software to do thermal analyses in March at 11 a.m., 12 p.m., and 2 p.m. in order to maintain a constant rate of mass flow. GAMBIT 2.4 is utilised for simulation, while ANSYS FLUENT 14.5 is used for analysis. From 11 a.m. until 2 p.m., the FPC simulation is run. When the temperature of the water input is 25 ° C at 12.00, the starting temperature is greater at 40.89 ° C, thus the temperature rises to 15.890 C and the output temperature falls as time passes.

V. Y. Chaudhary et. al. (2017) The research uses CFD modelling to demonstrate how solar energy is utilised, including an evacuated tube heat pipe that transforms radiation into usable heat. Concerns have been raised about the present usage of nanofluids to enhance heat transmission in solar thermal technology. In geometry, there are two water pipelines. Water and Al_2O_3 are the working fluids of heat pipes, respectively. The thermal efficiency of nanofluids, which include solar water heater solar tube tubes, is higher than that of conventional sun water heater (SWH) tubular heaters. The impacts of mass flow rate and angle of inclination of the evacuated air pipeline results on the condenser were also studied.

M. Dinesh Babu et.al. (2016) There have been efforts to investigate the impact of fins externally connected to the riser pipe on the battery efficiency of a solar water heater. Study the solar collector with or without computational fluid dynamics (CFD) to detect the solar collector to get a better picture of the heat exchange capabilities of the collector. The tests for finned tube acquired from CFD were verified by CFD, and test values for plain tube were seen, as well as temperature rises of 3-4 degrees C for finned tube. Manufacturing and experimental testing using the most recent collector collection are done on this basis. The results of the test show that using finned pipes instead of the basic tube improves effectiveness by around 3-5 percent.

Sukrut Surendra Prabhu (2016) The present research involves doing a three-dimensional CFD analysis to enhance the efficiency of solar air heaters. In this research, a circular barrier in the flow channel is utilised to increase flow turbulence and therefore convective heat transfer to air. Experimental data for the model with and without barriers is used to verify the numerical results. Barriers are helpful for enhancing the rate of heat transmission, according to the findings. Despite the inclusion of the barrier, the pressure drop has risen in comparison to the plane template. This enhanced pressure loss was minimised by adding fillet in the flow direction.

Vishal G. Shelke et. al. (2015) The goal of this study was to see how changes in tube size affected the flat platform solar collector. This thesis used the software ANSYS CFD FLUENT to do numerical analysis on a circular tube with a diameter of 12.7 mm. Different heat streams had their entrance and exit temperatures compared. Separate elliptical pipe shapes have been subjected to further analysis. The liquid outflow temperature is compared to the circulation tests. In contrast to the ring and other elliptical configurations for the same heat flow and input temperature, case 5 (b=0.5A) elliptical pipe delivers maximal output water temperature. 4.17 °C is also proven to be the greatest temperature difference between the circular and elliptical tubes.

Zaw Min Thant et. al. (2015) The following numerical study is given on the collector of a water-in-glass solar tube evacuated using computational fluid dynamics (CFDs). When it comes to solar-heated water heaters, the evacuated water in glass tank is a critical part of the system. An evacuated collector with water in glass is the most frequently used kind of evacuated collector because of its high hot spring efficiency, simple construction requirements, and low production costs. Specifically, the purpose of this paper is to contribute to previous research by approaching the transitional analysis of a removed tube collector using different geometries and tube geometries, which will allow for better heat removal from the tube and evaluating the behaviour, as well as potential improvements to the solar collector model, in order to improve on previous findings.

Jinshah Basheer Sheeba et. al. (2014) The application of finite element methods by the asphalt solar collector is the subject of this study, which comprises a combined thermal and structural analysis. In the particular scenario, several models for optimal tube length, tube size, tubing depth, and tube layout were examined. According to the statistical study performed on ASC, both pipe lengths and tube lengths have a significant effect on the temperature distribution inside the earth. Structural integrity is not significantly affected below a particular level. Because the structural and thermal characteristics of ASC change depending on the present temperature, blending ratios, and paving compactness, precise results can only be anticipated via real-time testing of big projects.

Sohel Chaudhari et. al. (2014) A CFD-based study of solar air heaters has been carried out utilising FLUENT in fluid flow and heating. The 3D Solar Air heater prototype was developed by ANSYS and included a water intake, absorber base, glass, an ANSYS Workbench template, and an unstructured grid. The tests were passed using ANSYS fluent code. The employment of a CFD system for flow distribution and temperature in the solar air heater achieves this. In the experiment, the heat transmission and fluid friction behaviour of the solar air fine heater on the ground of the absorber panel were investigated using a mathematical simulation. The effect of different heat flow values on solar air heaters has demonstrated that heat flow prices improve the heat efficiency of solar air heaters.

Basavanna et. al. (2013) The goal of this research is to investigate the solar collector by using CFD to monitor the solar collection and get a better knowledge of the collector's heat transfer capabilities. In the collector panel, Computational Fluid Dynamics (CFD) is being used to study fluid flow and heat transmission. Fluent CFD code is used to simulate the heat transfer between the collector and the air. Because this set-up tube has a greater contact area between the tube and a plate, and therefore higher heat absorption and fan efficiency, the temperature in the bottom panel of the absorber is quite high.

P.W. Ingle et. al. (2013) A numerical simulation of a solar collector designed only for the purpose of drying grapes was shown. Solar drying of grapes is both technically and economically feasible. To better understand the heat transfer potential of a computer-generated fluid dynamics instrument, CFD is being utilised to simulate the solar collector in current research. An air intake, a wave-built absorber sheet, a winding glass wrap plate and a stem board, as well as the organised ANSYS ICEM grid, are all included in the ANSYS Workbench 3D model. The air flow in the solar flat panel holders is not adequately dispersed, according to the CFD study. To address this problem, a fan inlet may be utilised to increase the power of the flat solar panel stack.

Alkhair M. Abdul Majeed et. al. (2012) Concentrate materials were utilised to raise the temperature of the water flowing through a flat plate absorber solar water heater's output. Simulation (modelling) technology was utilised to validate the findings produced from the numerical solution achieved using another technique. By raising the temperature of the water throughout the length of the absorber pipe, this research improved the thermal efficiency of plate solar water heaters. The temperature of the water floating inside a single panel solar water heater absorber was raised utilising focusing components. Simulation (modelling) technology was utilised to test the consequences of the numerical solution produced using another technique. By raising the water temperature of the absorber pipe throughout its length, this research has improved the energy efficiency of the solar water heater plate.

VI.CONCLUSION

The technological foundation of these installations has been investigated, and it is well understood that the design process must be selected, implemented, and monitored in line with the available sunlight and geographical circumstances of the solar water heating system. The design elements and associated technological advancements in the SWH system were reviewed briefly, primarily in terms of energy efficiency and cost effectiveness. Several solar water heating technologies have been developed, and they are more frequently utilized in tropical developing countries. Solar collector technology has been successfully created to utilize solar power as a dependable source of heating for solar-adverse regions, based on recent developments in thermal tubes. The use of heat pipes to heat water from the sun has a number of environmental implications, including the need of a cooling agent.

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