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REVIEW ON HYBRID SOLAR AIR HEATER

C.B. Saxena[1*]

[1]*M.Tech Scholar, Department of Mechanical Engineering, RGPV,Bhoppal (M.P.)*

Abstract

The primary component of a solar energy usage system is a solar air heater (SAH). Thermal energy is generated at the absorbing surface of this kind of air heater, which is subsequently transferred to a fluid running through the collector. Because of their intrinsic simplicity, SAHs are the most often utilised collecting devices at a low cost. When it comes to solar-heated air systems, there are three main uses: heating buildings and drying wood and agricultural crops. For example, solar energy may be used for a variety of purposes including generating electricity, heating or cooling a building's interior area, powering air conditioners and heat pumps, and generating chilled water for industrial processes. Due to their versatility and ability to provide considerable environmental advantages, solar energy systems should be used wherever feasible.

Keywords: Solar energy; renewable; air heating; solar collectors; solar air heater.

1. Introduction

There are several ways to use solar energy, such as heating and generating electricity, but the most common is via harnessing solar radiation. Earth's present and future energy needs are dwarfed by the quantity of solar energy available. This widely dispersed energy source, if properly exploited, has the potential to provide all of humanity's future energy demands. With its endless supply and non-polluting quality, solar energy is predicted to become more popular as a renewable energy source in the 21st century. This contrasts with fossil fuels, which are finite. Solar energy has a huge potential since the Earth receives around 200,000 times the world's daily electric-generating capacity in the form of solar energy every day. Despite the fact that solar energy itself is free, the high costs associated with its

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2. INTRODUCTION

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2.1. Solar Air Heater:

Rather than replacing your heating system, a solar air heater is meant to augment it. An ideal location for a solar air heater is one where warm air may be diffused directly into an area of the house that is often used during daylight hours. Using the well-known scientific theory that warm air rises and cold air sinks, the solar air heater pumps cooled air from the bottom of a room into the solar collector where it absorbs heat before being blown back into the room. The air that travels through a solar air heater is heated using solar collectors positioned on the roof, wall, or window of the heater. Ideally, the solar collector should be placed on a south-facing roof or wall, away from any trees, tall buildings, or other potential sources of shadow. Installing smaller window units under a sunny south-facing window is a viable option. Because it extends through the window, this form of solar air heater eliminates the need for ducts or vents to allow air to circulate. At night or on overcast days, these direct-transfer units won't be able to transmit heat, therefore they can't be used.

Heat sinks are materials that can absorb and store heat for a brief period of time in bigger systems. Excess heat is transported to the heat sink throughout the day and then transmitted to your residence after the sun sets. Adding a heat sink to a retrofit heating system may prolong your usage of solar thermal energy into the night, but the cost is prohibitive. It's also dangerous to your health, so be careful. The development of mould and bacteria on rocks is facilitated by the accumulation of moisture in a heat sink. Your house will be filled with these toxins if you use a blower to draw warm air from a heat sink.

To minimise bulk and enhance total heat transmission, the solar heater mixes parallel and counter flows inside the heater itself. SAHs with complex geometry, such counter flow heaters or parallel flow heaters, cannot be modeled using current methodologies. Experiment and computational fluid dynamics are used to assess the solar air heater. Experiments are used to verify the accuracy of the computer models. Solar radiation, conduction, convection and turbulence are all taken into consideration by the computer models. A turbulence model screening is carried out. Both the average conversion and the average collector efficiency fall within the range of 23 to 83 percent. Depending on the amount of solar radiation power input, computational models overestimate thermal efficiency by 6.75 percent to 9.01 percent.

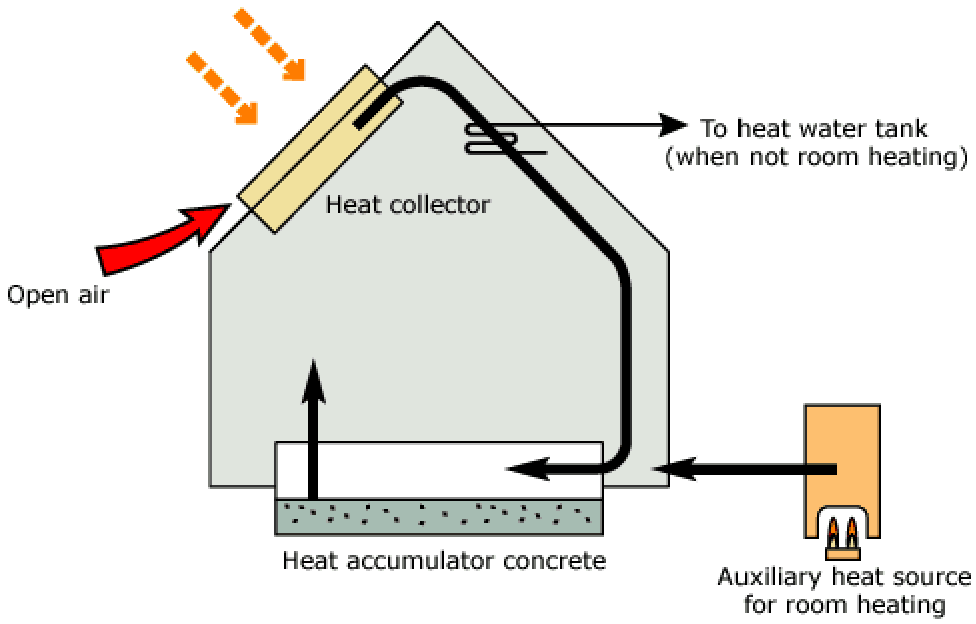

Figure 1: Diagrammatic Representation of Solar Air Heater

2.2. Types of Solar Air Heater

Porous type Solar Air Heater:

Porous absorbers, such as sliced and expanded metal, overlapping glass plate absorber, and transpired honeycomb, are used in the second kind of air heaters. With a porous absorber, sir heaters have the following advantages: The sun's rays penetrate far into the atmosphere and are absorbed by the atmosphere as they travel. As a result, less radiation is lost. The matrix warms up the air stream as it travels through it. Porous materials have a smaller pressure drop than non-porous materials.

However, an incorrect choice of matrix porosity and thickness may result in a decrease in efficiency, since the matrix may not be hot enough to transmit heat to the air stream beyond an ideal thickness. Examples of porous absorbers used in solar air warmers include wire meshes made from shattered bottles, and glass plates that have been overlapped.

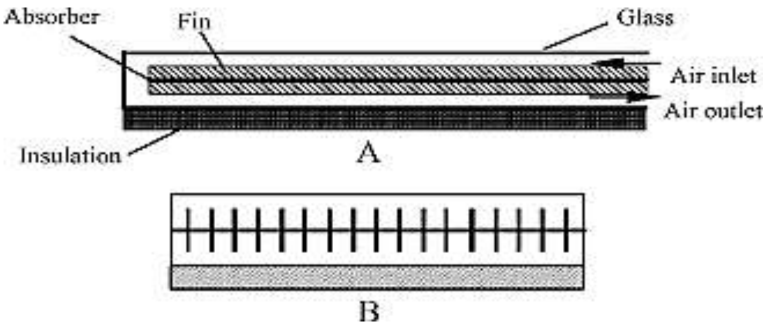

Figure 2: Diagrammatic Representation of Porous Type Solar Air Heater

Non-Porous Type Solar Air Heater:

Non-porous absorber plates do not allow air to flow below the absorber plate, but air may flow above and behind the plate. In the first kind, there is no need for a separate path for the air to move between the absorber plate and the clear cover system. The figure shows (as an example). Flowing hot air above the absorber heats up the cover, which then radiates heat back into the room. A large quantity of heat is lost to the surrounding environment, and so this air heater is not recommended for use. Non-porous absorbers with air passages underneath the absorber are the most prevalent. Between the absorber and the insulation is a plate parallel to the absorber plate, resulting in a passage with a high aspect ratio.

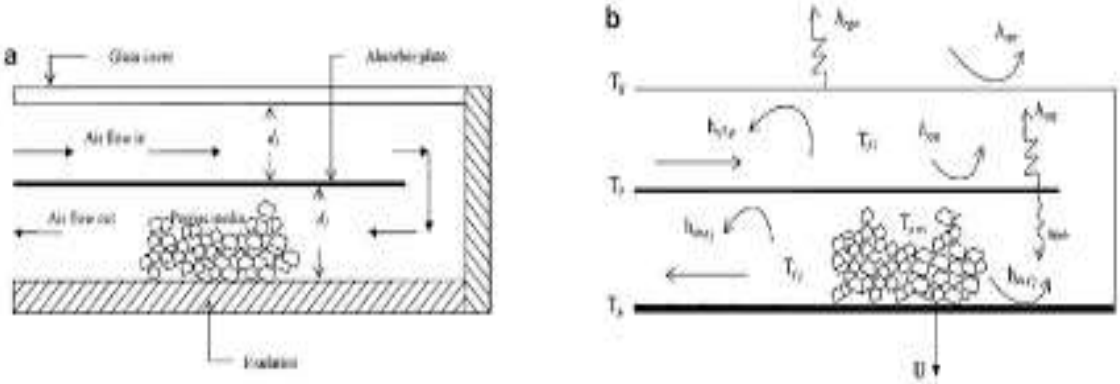

Figure 3: Diagrammatic Representation of Porous Type Solar Air Heater

3. LITERATURE REVIEW

(E.A. Cha´vez-Urbiola, Yu.V. Vorobiev, L.P. Bulat, 2012) (Chávez-Urbiola et al., 2012) In solar hybrid systems, thermoelectric generators have been considered as a potential. A total of four systems were analysed, including a traditional PV/Thermal geometry with TEGs between the solar cells and heat extraction device and three systems that used concentrators, namely: Concentrator – TEG heat extractor, and PV cell – concentrator – TEG heat extractor The power produced has a quadratic temperature dependency due to the linear relationship of current and voltage on temperature.

(Rashid Al Badwawi, Mohammad Abusara ,Tapas Mallick, 2015) (Al Badwawi et al., 2015) If more solar and wind power is included into the electricity grid, it might cause and generate considerable technological hurdles, particularly for weak networks or stand-alone systems without enough and sufficient storage capacity. When solar and wind resources are used together, the volatile nature of solar and wind resources may be alleviated, and the whole system becomes more dependable and affordable to operate. Hybrid solar PV/wind energy integration systems face a variety of problems and possibilities. "Grid-connected and stand-alone systems" are equally vulnerable to voltage and frequency fluctuation and harmonics, which have a greater effect in the event of a weak grid. As long as the hybrid systems are properly designed and implemented, this issue may be greatly alleviated.

(Shuvankar Podder, Raihan Sayeed Khan, ShahMd Ashraful Alam Mohon, 2015) (Podder et al., 2015) In order to fulfil a daily power demand of 276 kWh with a peak load of 40 kW, this research found the optimal size and economic assessment of a solar-wind hybrid RES. The hotels in Patenga, Chittagong, where the load data was gathered, were used. Independent and grid-connected versions of RES have been proposed. Based on "net present cost (NPC)" and energy cost per unit, the best system designs have been identified. An 8 percent yearly capacity shortfall allows for a stand-alone hybrid solar wind battery system to be economically similar to the current cost of diesel-based power plants. Renewable energy sources (RES) account for more than 70% of the total power generated by a grid-tied solar-wind hybrid system. Grid-tied RES also reduces greenhouse gas emissions by more than 60% compared to the traditional grid. This research used sensitivity analysis to examine the impact of changing capital costs or the availability of renewable resources on the system economics. This research will use the programme "Hybrid Optimization of Multiple Energy Resources (HOMER)" as its major simulation tool.

(Sumit Wagh, Dr. P.V.Walke, 2017) (Wagh & Walke, 2017) It is a vital aspect of the country's development and economy. Coal, oil, and natural gas make up the bulk of our energy supply. As we all know, energy is required for industrial, agricultural, commercial, and home purposes, as well as for other purposes. Global energy consumption is rising at an ever-increasing rate. Coal, fossil fuels, oil, and other gases may be used to generate energy. However, all of these sources are hazardous to the environment, thus there are restrictions on their use and they are restricted. For the sake of the environment, we need a source of renewable, pollution-free power. Eco green energy, or creating energy without causing damage to the environment, is the current emphasis in today's globe. Renewable energy sources including sun, wind, small hydro, and biomass, as well as biofuels, are available in this situation. Using renewable energy to meet the world's energy needs has a great deal of promise. The utilisation of renewable energy sources has its drawbacks, and a lot of research is being done to increase their efficiency.

Wenke Fan, Georgios Kokogiannakis, Zhenjun Ma, 2018)(Fan et al., 2018) there is a dearth of guidelines for effective hybrid PVT-SAH system design and a high degree of complexity in its creation; Multi-objective design optimisation will be used to maximise the conflicting outputs of useable thermal energy production and net electricity gains concurrently. ANOVA is used to create the simulation exercises and identify the non-significant system factors in order to lower the optimization size. Multi-objective optimization problem is then created to find the best values of critical design parameters. From the resulting collection of Pareto fronts, the final optimum design is selected using a decision-making process based on TOPSIS. The sensitivity analysis decreased the number of factors from twelve to seven and found that the material parameter and the thickness of building components are not critical to the performance of the PVT-SAH.. 21.9 percent and 20 percent improvement in useable thermal energy and net electricity gains can be achieved under the parameters of this research by the final determined optimum design, whereas the second selected baseline design can be improved by 24.7 percent and 126 percent.

(M. H. Masud, Raju Ahamed, M. Mourshed, M.Y. Hossan & M. A. Hossain, 2019) (Masud et al., 2019) In recent years, several SAH have been created that have a better efficiency but are more expensive to install in underdeveloped nations. In this case, a more affordable SAH with improved solar energy use and improved efficiency has been designed by combining a fin with the SAH. Air mass flow rate (MFR) was varied from 0.0132 kg/s to 0.02166 kg/s for both the connected and unattached fin configurations. A pyrometer was used to monitor the temperature of the air entering and exiting the heater, and an anemometer was used to measure the flow rate of air leaving the heater. The blower's output was where the anemometer propeller was mounted. Several measurements of speed were made before settling on an average speed for the sake of taking a reading. In the range of 0.0132 Kg/s to 0.02166 Kg/s, the performance of single-pass solar air heaters with and without fins was evaluated, and the mass flow rate was examined.

(Peter Jenkins, Monaem Elmnifi, Abdalfadel Younis, Alzaroog Emhamed, 2019) (Jenkins et al., 2019) Any country's economic and social progress depends on the availability of energy. To reduce reliance on imported fuels, it is necessary to maximise the development of domestic energy resources while also addressing issues of economics, the environment, and society. Research and development in the renewable energy sector have increased as a result, in an effort to find new and better solutions to fulfil the world's energy needs while also reducing reliance on fossil fuels. Wind and solar power are becoming more popular because of their quantity, availability, and simplicity of use in the creation of electricity. This research focuses on a hybrid renewable energy system that includes both wind and solar power. Using maps, we were able to locate areas with great potential for wind and solar energy production in many different sections of Libya. An emphasis of this article is on a wind-solar hybrid power generating system for a specific site.

(Armin Razmjoo, et.al., 2019) (Razmjoo et al., 2019) Fossil fuel emissions of greenhouse gases are the primary sources of air pollution and a grave danger to human health. One of the greatest ways to avoid and decrease this issue in the future is to use a hybrid renewable energy system, as previously discussed. There are a variety of ways to calculate CO2 emissions, and Homer software is one of them. A variety of methods exist for calculating CO2 emissions, however the following equations were developed using the hybrid energy system that combines UN objectives, Urban Themes, and a techno-economic analysis to use solar and wind power in two Iranian cities.

(Ramadoni Syahputra, Indah Soesanti, 2020) (Syahputra & Soesanti, 2020) Central Java in Indonesia is a prime location for a hybrid micro-hydro and solar photovoltaic system. With a strong focus on renewable energy, particularly solar and hydropower, the Indonesian government has invested heavily. The province of Central Java, situated on the Indonesian island of Java, has a significant potential for both sources of energy. As part of this study, we perform field research to identify the optimum capacity of solar and micro-hydro hybrid power plants, energy load analysis, and the best design of hybrid power plants. It is possible to gather information on the micro-hydrological potential by taking measurements directly on the Ancol Bligo irrigation channel in Indonesia's Central Java province's Bligo village, Ngluwar district, and Magelang regency. NASA's database of solar radiation in Central Java provided information on the region's solar power potential. The length, debit, heads, and power potential of irrigation canals leading from rivers are all included in the statistics on hydropower potential. Using this information, an ideal hybrid power plant may be designed. The examination of capital costs, grid sales, energy expenses, and net present costs is the strategy used to get the best hybrid power plant design.

(M.S.W. Potgieter, C.R. Bester, M. Bhamjee, 2020) (Potgieter et al., 2020) They may be used for room heating, pre-heating for industrial purposes such as drying of different materials and pre-heating for solar water de salinators. A novel solar air heater design is being evaluated for thermal efficiency and temperature distributions inside the solar air heater as part of this study. To minimise bulk and enhance total heat transmission, the solar heater mixes parallel and counter flows inside the heater itself. SAHs with complex geometry, such counter flow heaters or parallel flow heaters, cannot be modeled using current methodologies. Experiment and computational fluid dynamics are used to assess the solar air heater. Experiments are used to verify the accuracy of the computer models.

4. CONCLUSION

Several of the most popular solar collectors are discussed in this article. Flat-plate, compound parabolic, evacuated tube, parabolic trough, Fresnel lens, and parabolic dish collectors are among the different kinds of collectors mentioned. In addition, examples of common uses are provided to demonstrate the reader the breadth of their use. Heating and cooling applications range from water heaters to room heating and cooling, refrigeration to desalination to thermal power systems to solar furnaces. It's important to remember that solar energy collectors don't only have to be used in the places listed above. Other apps that aren't mentioned here are either still in development or haven't matured enough to be included. Using solar collectors in a range of systems may have a substantial environmental and economic impact, and they should be employed wherever practical, according to the application areas specified in this article.

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