

An Implementation & Utilization of Solar Water Heater by using Boiler Waste Heat Recovery Method

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Abstract— Presently peoples are need to hot water for domestic and commercial purpose. Solar energy is the main alternative to replace the conventional energy sources. There are different types of solar water collector system available in the commercial market to fulfil the customer's demand, such as flat plate collector, concentrating collector, evacuated tube collector and integrated collector storage. Which combination of solar collector for heating the water system with heat exchanger to recovery the boiler waste heat. The more waste heat are available in environment such as house hold Refrigerator, IC Engines etc. So the boiler Waste heat recovery system is the best way to recover the waste heat and saving the fuel. The recovery and utilization of waste heat not only conserves fuel but also reduces the amount of waste heat and exhaust gas emission to the environment. So it will be control the global warming and energy crises. This paper concentrated to the no delay of energy saving process and improving performance efficiently. This waste heat converted in to use full energy and also reduce the environmental pollution. The boiler waste heat will transfer to heat exchanger and combined to solar water collector for heat the cold water into hot water. Therefore it is energy saving and economically based system.

Key words: Waste Heat Recovery Method, Global Solar Radiation, Energy Crises

I. INTRODUCTION

The Energy resource is mainly two different types: Renewable Energy resources, Non-Renewable Energy resource. Renewable Energy resource is reused energy source including solar energy, wind power, hydraulic energy, geothermal energy and biomass energy and non-renewable resource is cannot be reused, such as petrol, nuclear energy, coal and natural gas. One of the most important renewable-energy resources is the solar energy. Early morning and night time sun raise not available in solar water collector so that time the boiler waste heat is possible to heat the cold water. It is converted cold water into heat water is the main benefit of our project. Waste heat recovery method is used to convert waste energy into useful energy. The more waste heat are available in environment it will be Heat recovery is the one way among others for energy saving technologies. It does not only help to save energy but also to decrease the environmental impact of energy generation systems simply by reducing the amount of CO₂ released to the environment. Heat recovery technologies frequently reduce the operating costs for facilities by increasing their energy productivity.

Three types of heat pipes are generally used: conventional heat pipe, two phase closed thermosyphon, oscillating heat pipe. The difference between a conventional heat pipe and a two phase closed thermosyphon is that the two

phase closed thermosyphon uses gravity effect to transfer the heat from a heat source that is located below the cold sink. The two phase closed thermosyphon heat pipe consists of three parts, which include the evaporator, adiabatic and condenser sections. The solar energy can be utilized to a large quantity in areas having through weather conditions such as India. The sun is emitted to solar radiations 1395W/m² to utilize this energy is used solar collector. The boiler waste heat and solar water collector are combined to heat the water through increasing performance. The aim of the project is to utilized the renewable energy and reduce the energy crises.

II. FABRICATION & EXPERIMENTAL SETUP

The solar water heater and combining of boiler waste heat. It is recovery the waste heat in to use full energy. The figure as shown in below.

A. Working Principle of Solar Water Heater

It is consists of a unit with dual operation, to absorb solar radiation and to preserve the solar heat, instead of the absorbing solar radiation and the heating only of the circulating fluid. When solar radiation from the sun is absorbed by the blackened plate, it is changed to heat. The heat is transfer to the flow tubes by conduction. The water through the flow tubes is in turn heated by the convection process between the tubes and the water grains. The heated water becomes warmer and less dense than the water in the storing tank. The cold water passed to heat exchanger it will make hot water. The hot water with lower density moves upward and cold water with higher density moves downward from the tank due to gravity head. These density difference results in flexibility force, often referred to as the thermosyphon head which makes a continuous convective movement of water from the bottom of the tank to the bottom of the collector, up through the collector flow tubes, and back into the top of the tank. The prototype of solar water heater system was constructed in the Adithya institute of technology campus hostel mess that is located at Coimbatore with latitude 11.1134° N and longitude of 77.0364° E.

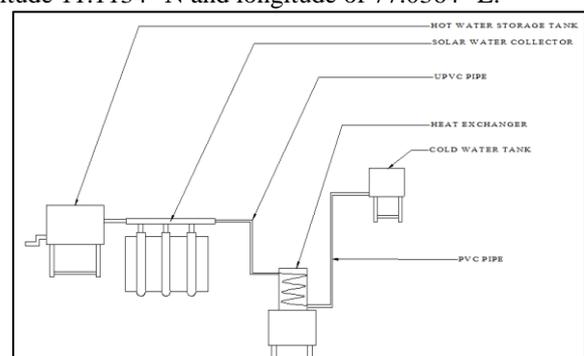


Fig. 1: Experimental Setup

B. Boiler Waste Heat Recovery System

Boiler waste heat recovery method is converting the waste heat into useful energy. Heat exchanger mainly classified based on relative direction of fluid motion is parallel flow, counter flow and cross flow heat exchanger. The boiler is mainly constructed in mess and industries for generating steam. So the exhaust flue gas is giving a heat it will converted in to use full energy. The copper tube is used for heat exchanger.

Copper has many important properties for thermally efficient and durable heat exchangers. Copper is a good conductor of heat. Another main properties of copper in heat exchangers include its corrosion resistance, biofouling resistance, maximum allowable stress and internal pressure, creep rupture strength, fatigue strength, hardness, thermal expansion, specific heat, antimicrobial properties, tensile strength, yield strength, high melting point, ease of fabrication, and ease of joining. Non-copper heat exchangers are also available like aluminum, carbon steel, stainless steel, nickel alloys, and titanium. This article focuses on beneficial properties and common applications of copper in heat exchangers. The copper tube is easily absorb the heat, 99.9% is added copper and silver.

C. V-Through Water Collector

The solar water collector is mainly consisting of stationary V-through collector. It is easily constructed and install in the rural areas with high thermal efficiency. In this system was designed to concentrate the sunlight to the absorber in order converted in solar energy in to thermal energy is effectively. The V-through collector constructed using different two type rectangular faces Stainless steel 304 and 60° angle relative to the absorber plate. The V-through reflector aligned horizontally along East and West direction. The ideologically The V-through reflector should be south facing and inclined at the angle of equal to the local attitude. The overall performance is minimum effect to the mechanical structure of the prototype. So we decided to place the V-through reflector in horizontal since the local latitude is only 11°N.

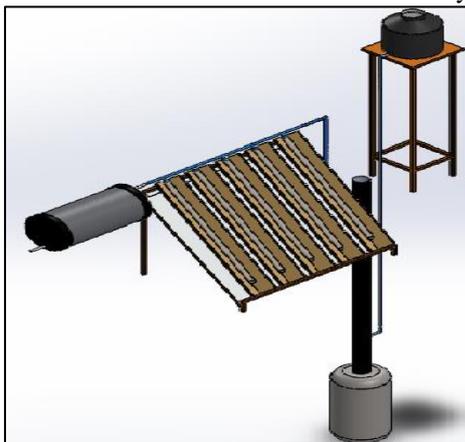


Fig. 2: Experimental Setup

III. RESULT & DISCUSSION

- The measuring incidents of solar radiation and other parameters are carried out at different intervals. Morning 9:00 A.M to Evening 4:00 PM in every day.

- The 5 Liter water is continuously removed from 50L water tank at each 30 minutes.
- The graph shows in Efficiency and the different value of temperature in various three points from apparatus. It is continually measured from 7th March 2018 to 10th March 2018 between 9:00 A.M to 4:00 PM.

A. Investigate During Experiment

The experimental processes are noted in some observations. All readings are surmised in a graphical form with necessary data. Nomenclatures are shown, used in the observation's tables:

- I Solar radiation - W/m²
- T1 Ambient Temperature °C
- T2 Inlet Temperature of water to Heat Exchanger °C (Approximately 25°C)
- T3 Temperature of outlet the Heat Exchanger °C
- T4 Temperature of outlet the setup (after ETC tube) °C

B. Thermal Analysis of Solar Water Heater with Boiler Waste Heat Recovery

In this section temperature measurements were done at various locations of experimental setup (i) Before heat exchanger (ii) After exchanger (iii) After Evacuated tube. And show these measurements in graphs for all experimental conditions. The K-Type thermocouples are used for Measuring temperature and recordings at three locations in Experimental Set-Up.

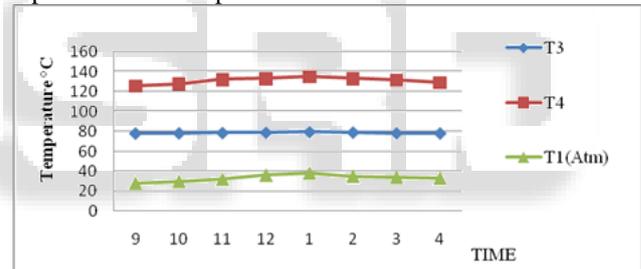


Fig. 3: Three Temperatures at Various Points on 07th March 2018 between the Time Intervals of 9:00 am to 4:00 pm

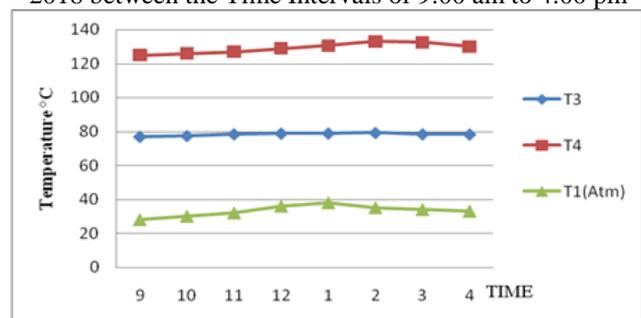


Fig no: 4 Three Temperatures at Various Points on 08th March 2018 between the Time Intervals of 9:00 am to 4:00 pm

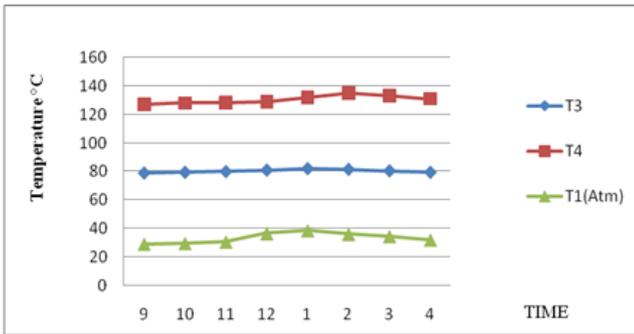


Fig. 5: Three Temperatures at Various Points on 09th March 2018 between the Time Intervals of 9:00 am to 4:00 pm

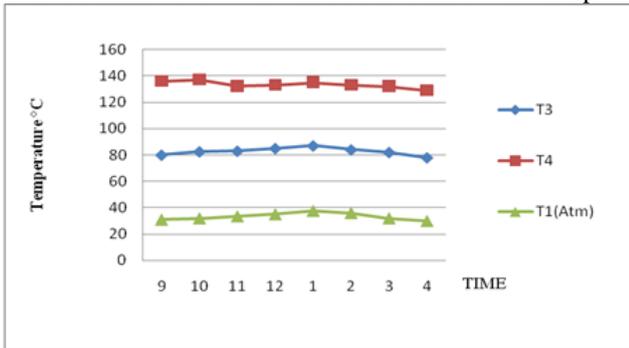


Fig. 6: Three Temperatures at Various Points on 10th March 2018 between the Time Intervals of 9:00 am to 4:00 pm

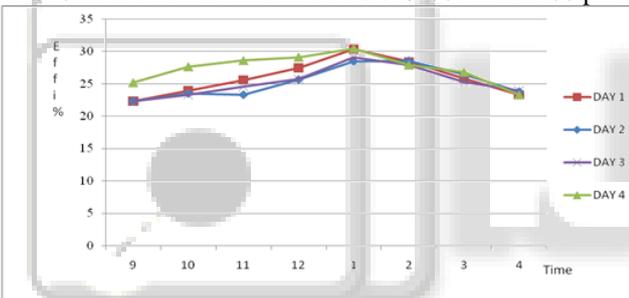


Fig. 7: Efficiency on 07th to 10th March 2018 between the Time Intervals of 9:00 am to 4:00 pm

IV. CONCLUSION

- In this project giving a development of pollution control from exhaust and reduce the energy crises.
- The performance of the solar water heater by using boiler waste heat recovery method can be increased in 5% of efficiency compared to normal solar water collector.
- The project is constructed simply and low cost of product.
- The hot water is use full for the cooking purpose and college hostel purpose.
- The project is investigated to heat exchanging materials and properties of materials with capacity.

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