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Experimental Investigation on V-shape Flat Plate Collector

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***Abstract*: In this Work investigated There are various types of solar water heater system available in the commercial market to fulfill different customers' demand, such as flat plate collector, concentrating collector, evacuated tube collector and integrated collector storage. A cost effective cum easy fabricated V-shape solar water heater system using forced circulation system is proposed. Integrating the solar absorber with the easily fabricated V-shape reflector can improve the performance of solar water heater system. In this Report, optical analysis, experimental study and cost analysis of the stationary V-trough solar water heater system is presented in details**

***Keywords*: V-trough solar collector, V-shape reflector**

1. Introduction

The purpose of any system that converts solar radiant energy into thermal energy is the useful application of the thermal energy itself. The application can be direct as heat or indirect by using the heat to drive a heat engine to produce useful mechanical energy or to use the thermal energy for electricity production. For this purpose, special devices are used called solar collectors. The purpose of a solar thermal collector is to absorb the radiant energy of the sun and to transfer the resultant heat to a fluid which in turn transfers the thermal energy to the site of application. In general, solar collectors are classified according to their thermal output temperature which determines also the field of their application.

This section deals only with low temperature solar collectors, the plane flat-plate collectors, which in general are simple devices easy to construct, to install and to operate. Flat-plate collectors are designed for applications requiring moderate temperatures usually up to 110°C above ambient temperatures. The simplest flat plate collectors are the solar ponds and the solar stills which operate by direct utilization of the incident solar radiation acting simultaneously as solar energy converters. The importance of flat-plate collectors is that their thermal performance can be predicted and treated in considerable detail. by direct utilization of the incident solar radiation acting simultaneously as solar energy converters. The importance of flat-plate collectors is that their thermal performance can be predicted and treated in considerable detail.

Solar collector: A solar collector is a device that collects and/or concentrates solar radiation from the Sun. These devices are primarily used for active solar heating and allow for the heating of water for personal use. These collectors are generally mounted on the roof and must be very sturdy as they are exposed to a variety of different weather conditions.

Types of solar collector

A. Evacuated tube collector

This type of solar collector uses a series of evacuated tubes to heat water for use. These tubes utilize a vacuum, or evacuated space, to capture the suns energy while minimizing the loss of heat to the surroundings. They have an inner metal tube which acts as the absorber plate, which is connected to a heat pipe to carry the heat collected from the Sun to the water. This heat pipe is essentially a pipe where the fluid contents are under a very particular pressure. At this pressure, the "hot" end of the pipe has boiling liquid in it while the "cold" end has condensing vapor. This allows for thermal energy to move more efficiently from one end of the pipe to the other. Once the heat from the Sun moves from the hot end of the heat pipe to the condensing end, the thermal energy is transported into the water being heated for use.

B. Flat-plate collector

These collectors are simply metal boxes that have some sort of transparent glazing as a cover on top of a dark-colored absorber plate. The sides and bottom of the collector are usually covered with insulation to minimize heat losses to other parts of the collector. Solar radiation passes through the transparent glazing material and hits the absorber plate. This plate heats up, transferring the heat to either water or air that is held between the glazing and absorber plate. Sometimes these absorber plates are painted with special coatings designed to absorb and retain heat better than traditional black paint. These plates are usually made out of metal that is a good conductor - usually copper or aluminum.

C. Line focus collectors

These collectors, sometimes known as parabolic troughs, use highly reflective materials to collect and concentrate the heat energy from solar radiation. These collectors are composed of

parabolically shaped reflective sections connected into a long trough. A pipe that carries water is placed in the center of this trough so that sunlight collected by the reflective material is focused onto the pipe, heating the contents. These are very high-powered collectors and are thus generally used to generate steam for Solar thermal power plants and are not used in residential applications. These troughs can be extremely effective in generating heat from the Sun, particularly those that can pivot, tracking the Sun in the sky to ensure maximum sunlight collection.

D. Point focus collectors

These collectors are large parabolic dishes composed of some reflective material that focus the Sun's energy onto a single point. The heat from these collectors is generally used for driving Stirling engines. Although very effective at collecting sunlight, they must actively track the Sun across the sky to be of any value. These dishes can work alone or be combined into an array to gather even more energy from the Sun. Point focus collectors and similar apparatuses can also be utilized to concentrate solar energy for use with Concentrated photovoltaics. In this case, instead of producing heat, the Sun's energy is converted directly into electricity with high efficiency photovoltaic cells designed specifically to harness concentrated solar energy

2. Flat-plate collector

A. Advantages

- Renewable Energy Source
- Reduces Electricity Bills
- Diverse Applications
- Low Maintenance Costs
- Technology Development

B. Disadvantages

- Cost
- Weather Dependent
- Solar Energy Storage is Expensive
- Uses a lot of Space

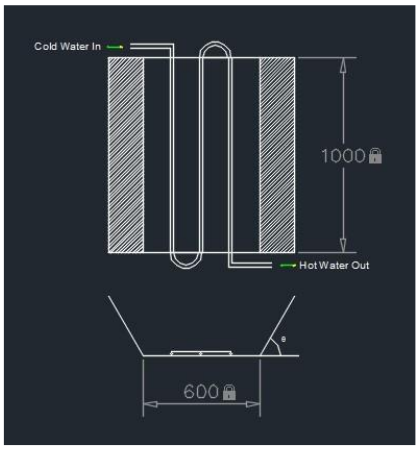

Fig. 1. Design of V-shape flat plate collector

Table 1
Technical Specification of V-shape flat plate collector

No.	Design materials/ parameters	Specifications
1	Reflector Angle	Find Maximum Efficiency Between 0^0 to 90^0.
2	Reflector	Mirror, length 1000 mm, Width 350 mm
3	Copper tubes	length 1000 mm, Diameter 10mm
4	Brass plate	Width 600 mm, length 1000 mm
5	Number of Copper tubes	3
6	Number of Copper Reflector	2
7	Connecting Pipe	Flexible PVC pipe
8	Pump	Low R.P.M

3. Conclusion

This paper presented the experimental investigation on V-shape flat plate collector.

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