

Study of Different Solar Receiver for Concentrating Collectors

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Abstract- In this research paper a survey the various types of solar thermal collectors and applications is presented. Initially, an analysis of the environmental problems related to the use of conventional energy sources which gives benefits offered by renewable energy systems are outlined. A historical introduction into the uses of solar energy is attempted followed by a description. There are various types of collectors including flat-plate, compound parabolic, evacuated tube, parabolic trough, Fresnel lens, parabolic dish and heliostat field collectors. Most common applications of the different types of collectors are presented in order to show to the reader the extent of their applicability. These include solar water heating, which comprise thermo-syphon, direct and indirect systems and air systems, integrated collector storage, space heating and cooling. Alternatively, more complex and expensive concentrating collectors can be used. These are devices that not only optically reflect but also focus incident solar energy onto a small receiving area. From result of this concentration, the temperature that can be achieved and the intensity of the solar energy is magnified.

Keyword's-- Solar Collector, FPC, HFC

I. INTRODUCTION

Since 1973, the word “energy” has been continuously in the news. There have been shortage of oil in many parts of the world and the price of this commodity has increased steeply. It is by now clear that the fossil fuel era of non-renewable resources is gradually coming to an end.[2] Every year the country is spending more than thousand crores for the import of oil. The serious problem in India the large amount pay in crude oil in other countries so the economy of our country becomes poor. No days one of the promising options to make extensive use of renewable sources of energy the solar energy can be use both directly and indirectly it can be use directly in verity in thermal application like heating of water or air, drying, distillation, and cooking.

The energy has large number of different forms. There are gravitational energy, radiant energy, heat energy, elastic energy, electrical energy. If we total of the formulas for each of this contribution. It will not change except for energy going in and out.

In previous discuss about the types of energy and how energy impact in Indian economy so the now we discuss about what are the essential parameter that mainly use for collect the ray of solar for making of electrical energy

II. COLLECTOR

One of the device which absorbs the incoming solar radiation, converts it into heat, and transfers this heat to a fluid (usually air, water, or oil) flowing through the collector.

There are basically two types of collector

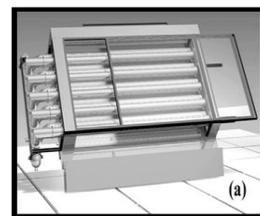
- a) Concentrating collector
- b) Non Concentrating collector

A non- concentrating collector has the same area for intercepting and for absorbing solar radiation, while a sun-tracking concentrating solar collector generally has concave reflecting surfaces to intercept and focus the sun's beam radiation to smaller receiving area.

Types of collector

- a) Flat plate collector
- b) cylindrical solar collector
- c) Concentrating collector
- d) parabolic collector

A) *Flat Plate Solar Collector:*



a) Fig.1: Flat plate collector [2]

Flat plate solar collectors utilize a flat absorber plate to convert the electromagnetic energy of solar radiation to heat.

They reduce heat losses to ambient the insulated front of the absorber is usually separated from the ambient by window the allows transmittance of solar radiation but impedance a heat losses from the absorber to the ambient.

The material of collector is copper stainless steel grid which is used to make a free space of 1 cm between the rear plate of the collector .the resistance of heat transfer is with conduit for heated fluid number of flat plate design in which the solar radiation absorber the directly into the flowing layer of heated fluid has been design and tested . the fluid is made more absorbent to radiation by adding suspension the absorber solar energy.

B) Cylindrical Solar Collector:

The design allows the use of relatively thin glass window containing insulating vacuum type air conditions between the absorber and outer glass window evacuation of the gap to reduce both convective heat losses the focus of sunlight on the collector axis centre



Fig.2: cylindrical solar collector

It is absorb on the surface of the absorber tube and transmitted to the fluid flowing through it. Concentric glasses over around the absorber tube help in reducing the convective and radioactive losses in the surrounding.

C) Concentrating Collector:



Fig.3 concentrating collector^[2]

The collector consist of concentrator collector and receiver. The concentrator as shown in fig the mirror reflector having the shape of cylindrical parabola. its become sunlight focusing the mirror to the axis where its absorb on surface on the absorber tube and transfer to the fluid flowing thought it. A glass cover around the absorber tube with the help of reflecting sun rays reducing the convective and radiative losses to the surrounding the fluid temp. up to 400⁰c can be achieve in cylindrical concentrating collector.

The fluid can achieve higher temperatures in a concentrator system when it compare with flat-plate system of same solar energy collecting surface. It means that a higher thermodynamic efficiency can be obtain. It is possible with a concentrator system, to obtain a thermodynamic match between task and temperature level. The task may be to operate thermionic, thermodynamic, or other higher temperature devices. Due to the small heat loss area relative to the receiver area thermal efficiency is greater.

Reflecting surfaces are structurally simpler and require less material than FPC. For a concentrating collector the cost per unit area of the solar collecting surface is therefore less than that of a FPC. The relatively small area of receiver per unit of collected solar energy, selective surface treatment.

D) Parabolic Collector:

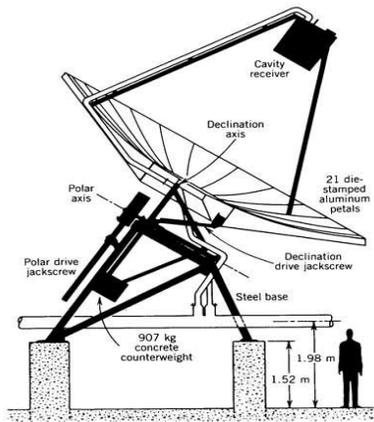


Fig.4: parabolic collector^[3]

The parabolic collector as show in fig. the operating temp. and as to be excepted it decreases and increasing temp. alternatively they can be use for obtaining the performance of solar thermal system the purpose of such system is to be store energy when it is in access of the requirement of an application make it in applicable energy store can be various forms thermal, electrical, mechanical,. Thermal energy can be store as sensible heat or latent heat. The temp. About 700⁰c absorb and heat transfer the energy of working fluid

These require two axis tracking so that the sun is in line with the fuscous and the vertex of parabolic dish concentrating. Parabolic though are devices that are shaped like “u” the through concentrate on to a receiver tube that is poisoned along the focal line of the through sometimes a transparent glass tube envelope the receiver tube to reduce heat loss (3).

III. NEED OF SOLAR ENERGY

Solar energy is very important because it can be easily available source of energy that can be used to businesses and power homes globally. Fossil fuels are finite, so it's important that alternative energy sources be embraced. As of 2014, it is widely believed that fossil fuels are causing global warming.

Another important use for solar energy is in satellites. Many satellites are engineered with photovoltaic panels, which absorb sunlight and convert it into electricity that is used to power the satellite. when standard electricity is not available in areas then solar power is also useful . For example, research facilities in Antarctica is totally depend on sustainable energy sources, such as the wind turbines and sun, to generate power.

Emergency phone systems in remote places often use solar power as a dependable power source. At night solar energy can also be used to power devices. For example, some streetlights are able to charge energy from the sun during the day, then run throughout the night.

IV. FUTURE SCOPE

The units of energy production can be developed in the various regions by using thermoelectric modules. In these days the society face the energy crisis but also the harmful effects of pollution. Thermoelectricity is very good for “Green Technology” to generate electricity without any harmful effect. The educational institutions, furnace regions, , industrial areas, metro cities and other locations can be selected for the establishment of such energy centers where the waste heat can be easily available and can be recycled after conversion to the same system.

The solar industry's structure will rapidly evolve as solar reaches grid parity with conventional power between 2016 and 2018. Solar will be seen more as a viable energy source, not only as an alternative to other renewable sources but also to a significant proportion of conventional grid power. The refinement and testing of off-grid solar models in the seed phase will help for a lead to explosive growth of this segment in the growth phase. According to one estimates, the combination of electricity demand growth, fossil fuel cost, and supportive environmental regulations could increase solar power capacity to more than 50 GW by 2022. The market will see a significant change after 2016.

V. BENIFITS OF SOLAR ENERGY

1. There exists many different advantages of solar power related to using solar energy on a large and small scale.
2. We are also able to produce solar power for our home through increasingly cheaper and easier methods related to this natural energy source.
3. One of the main advantages of a solar power system for your home is the lack of pollution given off by solar panels when generating electricity.

4. The pollution could associate with a solar power cell would be the production of the cell, and transportation of the cell until it reaches your home; also it maybe the use of electricity to power the tools needed while your panel is maintained installed. An example of a disadvantage would be the initial cost (one of the very few disadvantages associated with solar technology).
5. The initial investment of solar panels is quickly seen as a small price to pay when you realize the savings you could make over the coming months and years on your electricity bill.

VI. THERMAL APPLICATION OF SOLAR ENERGY

We will are study about various thermal application now discus in one by one.

A) Water Heating:

We begin with the description of water heating system one of the most attractive solar thermal application for economically the solar water heating are classified in two categories

1. Natural circulation
2. Force circulation

1) Natural Circulation-

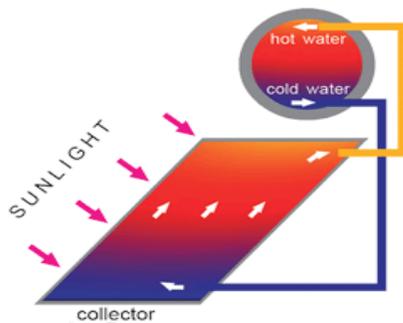


Fig-5 Natural Circulation

A simple small capacity of natural circulation system for domestic purpose the two main component of the system are liquid flat plate collector and the storage tank, this tank being located at the collector is heated by collector. As a water in the collector is heated by solar energy is flow in automatically to the water tank and its replace off by cold water from the bottom of the tank hot water are be use at the top of the tank and cold water enter to the bottom . solar water heater of the natural circulation .we are use Farelly widely in many countries beginning up to the 20th century till about 1940 years until the cheap oil and natural gas become available .

2. Forced Circulation System:

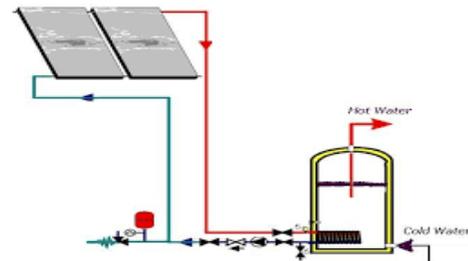


Fig.6 Force Circulation

When the large amount of hot water required for supplying process in an industry or commercial uses they are not suitable in natural circulation system. The large arrays of flat plate collector s are then used and forced circulation is maintained with a water pump .the pump for maintaining the forced circulation is operated by an off controller which sense the difference bet temp of water at the exit of collector and a suitable location inside the storage tank.

B) Space Heating

Space heating is a particular reliance in older countries where a significant amount of energy is required for this purpose in India it is of importance mainly in the northern and north eastern regions in winter.

- 1) Active method
- 2) passive method

1) Active Method:

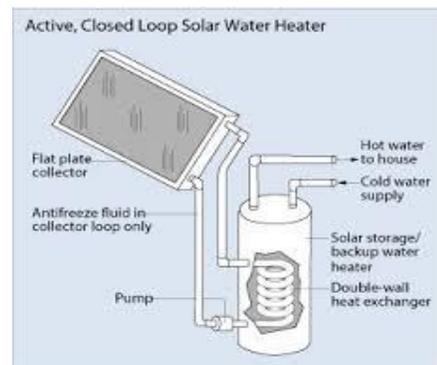


Fig.7 Active Method^[1]

We will first describe space heating system using active method. An active method is utilisation a pump or blower to circulate the fluid involve in the space heating system an alternative approach to space heating is to heat air directly in solar air heating.

2) *Passive Method:*

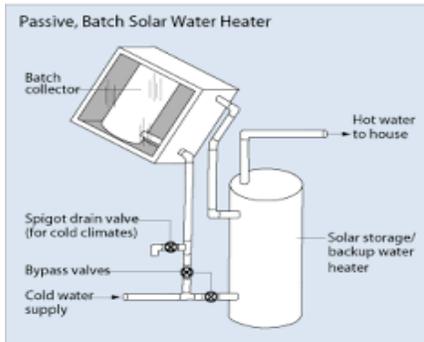


Fig.8 Passive Method^[1]

Passive method gives a fair degree of comfort. A passive method in which thermal energy flows through a living space by natural means without the help of mechanical device like a pump. A schematic diagram of passive space heating system is shown in figure. The face to the heated with provided with a single or double glazing. Behind it is a thick, black which absorb the sun radiation and serves as a thermal storage. Vents of the system can be kept open or closed are provided near the top and bottom of the storage wall. The whole unit consist of the storage wall with vents and glazing.

C) *Drying:*



Fig.9 Drying

Drying of agricultural product is one of the traditional use of solar energy. Drying helps to remove the moisture from agricultural product. Mostly it is done on open ground. Due to the open space of drying it add dust particle in the agricultural product. The use of dryer helps to eliminate these disadvantage. Drying then can be done faster and in a controlled fashion. Due to this we obtained better quality product.

VII. HEAT LOOSES FOR THERMAL RECEIVER

Top Losses:

The top loss can be determine by considering convection and radiation losses from the absorber plate, in the upward direction. Four assumption are made for the determination of top losses-(i) transparent and absorber plate create a system of infinite parallel surface. (ii) The flow of heat is one dimensional and steady. (iii) It gives negligible temperature drop across the thickness of cover (iv) For long wavelength the transparent cover acts to be opaque.

Bottom Losses:

To determine the bottom loss consider the conduction and convection loss from the absorber plate in the down word direction trough the bottom of the collector. It is assume that heat flow is one-dimensional trough conduction only, neglecting the convective loss.

Side Loss:

The side is calculated by considering the dimensions of the absorber plate as L1&L2with height L3.[7]

VIII. CONCLUSIONS

Most commonly used type of solar collector are discussed in this paper. The various types of collectors described include Fresnel lens, flat-plate, parabolic trough, Heliostat field collector (HFC), evacuated tube, parabolic dish. The thermodynamic, thermal and optical analysis of collectors is also presented as well as methods to evaluate their performance. Additionally, typical uses are also described in order to show to the reader extent of their applicability. These include water heating, industrial process heat, desalination, thermal power systems, space heating and cooling, solar furnaces and chemistry applications. It should be noted that the applications of solar energy collectors are not limited to the above areas. There are so many other applications/uses which are not described here either because they are not totally developed or are not matured yet.

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