

“TO STUDY THE DESIGN AND PERFORMANCE OF FLAT PLATE COLLECTOR AND PARABOLIC COLLECTOR”: A REVIEW

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ABSTRACT

In today's world of much more environmental problems, solar energy is the most abundant available energy by the use of which we can gain a promising outcome. So we are focusing our main attention on solar collector design and performance. This solar collector uses the solar irradiation and generally used for various heating purposes, cooking, and so on.

I did the detailed study of flat plate collector and sk-14 (parabolic dish type collector) is made along with the fabrication of flat plate and complete setup (assembly and installation) of sk-14 collector. After installation of both collectors, temperature readings are taken at different time interval, also the graphs are plotted of time versus temperature range for surface (steel) and fluid (water). The efficiencies are also calculated on these bases.

.Keywords:- Flat plate collector, Parabolic dish type collector

1. INTRODUCTION

At present the problem of pollution is troubling the local inhabitant of this planet earth. It is just like a curse to this planet and its inhabitant. Moreover the uses of more and more conventional resources like petrol, diesel, coal etc are adding worries to this problem.

Therefore it's a great concern to turn towards the use of non-conventional resources like solar, wind, hydro energy. Also the greatest source of non-conventional energy is solar energy and it is available freely and in abundant quantity, but efficiency of solar power plant has not much enough to work with such valuable energy which is freely available. Now here my concern will be comparative study and improvement in existing design of solar collector which is the input of solar power system so that output can be improved.

My project will be on solar energy system and comparative studies of solar collector which is the main component (input device) of any solar energy system. Moreover we will be doing experimental study on collector's performance and finding their efficiency and also we will try to design new solar collector using magnifying glass in order to improve performance of collector and will conclude which one is the best.

2. LITERATURE REVIEW

Data collected from literatures:

Flat Plate Collector

Of the many solar collector concepts presently being developed, the relatively simple flat plate solar collector has found the widest application so far. Its characteristics are known, and compared with other collector types, it is the easiest and least expensive to fabricate, install, and maintain.

Moreover, it is capable of using both the diffuse and the direct beam solar radiation. For residential and commercial use, flat plate collectors can produce heat at sufficiently high temperatures to heat swimming pools, domestic hot water, and buildings; they also can operate a cooling unit, particularly if the incident sunlight is increased by the use of a reflector. Flat plate collectors easily attain temperatures of 40 to 70°C. With very careful engineering using special surfaces, reflectors to increase the incident radiation, and heat-resistant materials, higher operating temperatures are feasible.

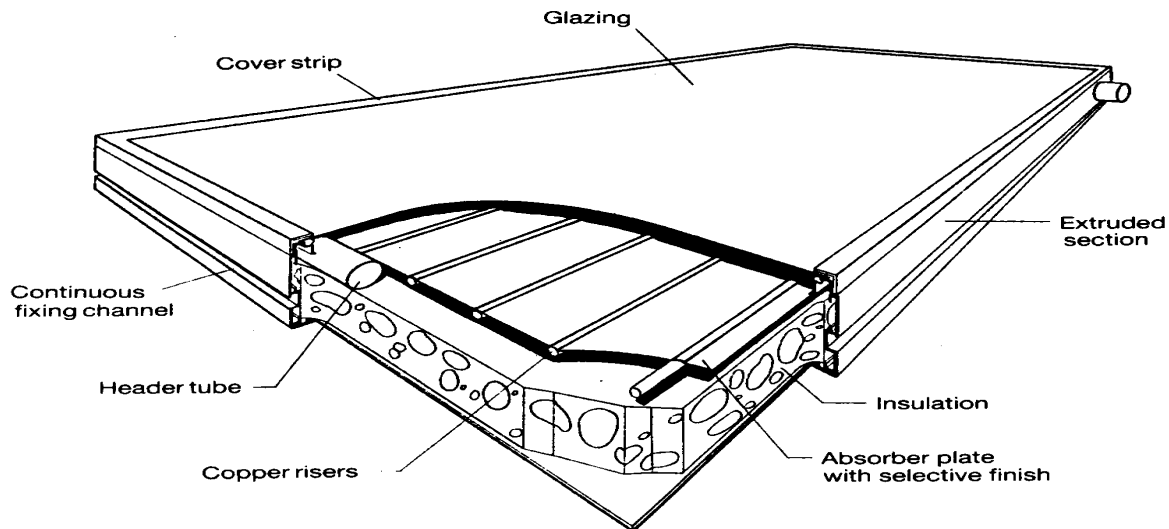
The main components of a flat plate solar collector are:

- **Absorber plate** made of any material, which will rapidly absorb heat from sun's rays and quickly transfer that heat to the tubes or fins attached in some manner, which produces a good thermal bond.
- **Tubes or fins** for conducting or directing the heat transfer fluid from the inlet header or Duct to the outlet.
- **Glazing**, this may be one or more sheets of glass or a diathermanous (radiation transmitting) plastic film or sheet.
- **Thermal insulation**, which minimizes downward heat loss from the plate.
- **Cover strip**, to hold the other components in position and make it all Watertight
- **Container or Casing**, which surrounds the foregoing components and keeps them free from dust, moisture, etc.

Flat plate solar collectors are classified into:

Water-type (hydraulic) collectors, using water as the heat-transfer fluid,

Air-type collectors, using air as the heat-transfer fluid



Diathermanous Materials (Glazing)

The term "diathermanous" is applied to materials capable of transmitting radiant energy, including solar energy. From the standpoint of the utilization of solar energy, the important characteristics are reflection (ρ), absorption (α), and transmission (τ). The first two should be as low as possible and the latter as high as possible for maximum efficiency. According to the law of conservation of energy, the relationship between the absorbed, reflected and transmitted energy is:

$$\alpha + \rho + \tau = 1$$

Where, α is the solar absorptance, i.e. the fraction of the incident solar radiation absorbed by a Substance.

ρ is the solar reflectance, i.e. the fraction of the incident solar radiation reflected by a surface.

τ is the solar transmittance, i.e. the fraction of the incident solar radiation transmitted through a

Non-opaque substance.

Absorber Plates

The primary function of the absorber plate is to absorb as much as possible of the radiation reaching through the glazing, to lose as little heat as possible upward to the atmosphere and downward through the back of the container, and to transfer the retained heat to the circulating fluid.

In general, absorption of solar energy impinging on an absorber plate should be as high as possible, but re-emission (loss) outward from the collector should be minimized.

Thermal Insulation

Flat-plate collectors must be insulated to reduce conduction and convection losses through

The back and sides of the collector box. The insulation material should be dimensionally and chemically stable at high temperatures, and resistant to weathering and dampness from condensation.

Usually, glass-wool insulation 10 cm thick is recommended. It would be better if the insulation also could contribute to the structural rigidity of the collector, but more rigid insulating materials are often less stable than

glass-wool. Temperatures in flat-plate solar collectors can be high enough to melt some foam insulations, such as Styrofoam. And some foam give off corrosive frames at high temperatures, which could damage the absorber plate

SK-14 solar cooker (collector)

Introduction to sk-14 solar collector

Sk-14 is a durable although light, cost effective to build and easy to use. Now here maximum amount of energy is desired, the dish must only be moved every 15-25 minutes to face the new position of the sun.

The heated area is located within the dish, therefore burning and blinding are easy to avoid. When the food is too bestirred, the reflector dish is simply rotated over the pot, so that the pot is in the shade.

It should be place on a level surface without any obstacles in the immediate cooking area.

In windy conditions it needs to secure by tying some little bags of sand to the frame to stop it blowing over and being damaged. Or by putting some steel pins pushed into the ground

The SK 14 is now normally sold in a kit form now called K14 the benefit of this kit is that it can be assembled where it will be used. No damage of misshape of the parabolic can take place during transport.

The SK14 is a very versatile solar cooker. In the rural areas it can take to the field where the farmer can cook his food while attending to his chores, then have Piping hot food for lunch.

It can be used for much other work where heating is necessary. Like ironing clothes, food processing such as making jam pickles snacks for packing etc.

Advantages:

- It is point focusing type collector
- Required less area compare to flat plate collector
- High temp.
- Flexibility obtain
- Low maintenance
- Easy to assemble

3. CONCLUSION

- ❖ Temperature range of parabolic collector (sk14) is more than the flat plate collector.
- ❖ Reading taken by us are matching the reference reading as compared in chart

Comparison:

Flat plate collector	Sk-14 (parabolic type)
1. Non concentrating type.	Point focusing type.
2. Absorber area of collector is more than parabolic type and thus insolation intensity	Absorber area is less compared to flat plate, thus more solar insolation.

is less.	
3. The working fluid attains low temperature than parabolic type.	The working fluids attain high temperature in comparison to flat plate.
4. Overall efficiency is around 14.7%	Overall efficiency is around 87%
5. More maintenance.	Less maintenance.

“Thus we can conclude that the sk-14 type parabolic collector is more efficient than flat plate type of similar configuration. i.e. We have taken same aperture area for both collectors and on that basis we compared them

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This paper gives information as under:

Collector Description

- Advanced Flat-plate Collectors
 - Evacuated Tube Collectors
 - CPC Collectors
 - Parabolic dish Collectors
 - Linear Concentrating Fresnel Collectors
 - Concentrating Collectors with Stationary Reflector
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