The plasticsare available at low cost, light in weight and can be used to make tubes, plates and cover but are suitable for low temperature application 70-120oC with single cover plate or up to 150oC using double cover plate. The thickness of glass cover 3 to 4 mm is commonly used and 1 to 2 covers with spacing 1.5 to 3 cm are generally used between plates. The temperature of glass cover is lower than the absorber plate and is a good absorber of thermal energy and reduces convective and radiative losses of sky.

(c) Absorber Plate:

It intercepts and absorbs the solar energy. The absorber plate is made of copper, aluminum or steel and is in the thickness of1 to 2 mm. It is the most important part of collector along with the tubes products passing the liquid or air to be heated. The plate absorbs the maximum solar radiation incident on it through glazing (cover plate) and transfers the heat to the tubes in contact with minimum heat losses to atmosphere. The plate is black painted and provided with selective material coating to increase its absorption and reduce the emission. The absorber plate has high absorption (80-95%) and low transmission/reflection.

The different factors affecting the performance of system are:

(a) Incident Solar Radiation: The efficiency of collector is directly related with solar radiation falling onit and increases with rise in temperature. (b) Number of Cover Plate: The increase in number of cover plate reduces the internal convective heat losses but also prevents the transmission of radiation inside the collector. More than two cover plate should not be used to optimize the system.

(c) Spacing:

The more space between the absorber and cover plate the less internal heat losses. The collector efficiency will be increased. However on the other hand, increase in space between them provides the shading by side wall in the morning and evening and reduces the absorbed solar flux by 2-3% of system. The spacing between absorber and cover plate is kept 2-3 cm to balance the problem.

(d) Collector Tilt: The flat plate collectors do not track the sun and should be tilted at angle of latitude of the location for an average better performance. However with changing declination angle with seasons the optimum tilt angle is kept $\Phi \pm 15^{o}$. The collector is placed with south facing at northern hemisphere to receive maximum radiation throughout the day.

Concentrating Collectors

Concentrating collector is a device to collect solar energy with high intensity of solar radiation on the energy absorbing surface. Such collectors use optical system in the form of reflectors or refractors. These collectors are used for medium (100-300o C) and high-temperature (above 300oC) applications such as steam production for the generation of electricity. The high temperature is achieved at absorber because of reflecting arrangement provided for concentrating the radiation at required location using mirrors and lenses. These collectors are best suited to places having more number of clear days in a year.

The area of the absorber is kept less than the aperture through which the radiation passes, to concentrate the solar flux. These collectors require tracking to follow the sun because of optical system. The tracking rate depends on the degree of concentration ratio and needs frequent adjustment for system having high concentration ratio. The efficiency of these collectors lies between 50-70%. The collectors need more maintenance than FPC because of its optical system. The concentrating collectors are classified on the basis of reflector used; concentration ratio and tracking method adopted.

FPC with Reflectors The mirrors are placed as reflecting surface to concentrate more radiations on FPC absorber. The fluid temperature is higher by 30oC than achieved in FPC. These collections utilize direct and diffuse radiation.

Lens Focusing Type The fresnel lenses are used to concentrate the radiation at its focus. The lower side of lenses is grooved so that radiation concentrates on a focus line.

Compound Parabolic Collectors These collectors are line focusing type. The compound parabolic collectors have two parabolic surfaces to concentrate the solar radiation to the absorber placed at bottom.

Cylindrical Parabolic Collectors

The troughs concentrate sunlight onto a receiver tube, placed along the focal line of the trough. The temperature at the absorber tube is obtained at nearly 400o C. The absorber in these collectors is moving to receive the reflected radiations by reflector, while the concentrators (trough) remains fixed. Because of its parabolic shape, it can focus the sun at 30 to 100 times its normal intensity (concentration ratio) on a receiver. The heat transfer medium carries the heat at one central place for further utilization.

Parabolic Dish Collector

The collectors have mirror-like reflectors and an absorber at the focal point. These collectors are point focusing type. The concentrating ratio of these collectors is 100 and temperature of the receiver can reach up to 2000o C. These collectors have higher efficiency for converting solar energy to electricity in the small-power plant. In some systems, a heat engine, such as a Stirling engine, is connected to the receiver to generate electricity.

Advantages of concentrating collector over flat collector

- The size of the absorber can be reduced that gives high concentration ratio.
- Thermal losses are less than FPC. However small losses occur in the concentrating collector because of its optical system as well as by reflection, absorption by mirrors and lenses.
- The efficiency increases at high temperatures.

• In these collectors the area intercepting the solar radiation is greater than the absorber area.

• These collectors are used for high-temperature applications.

• Reflectors can cost less per unit area than flat plate collectors.

• Focusing or concentrating systems can be used for electric power generation when not used for heating or cooling

• Little or no anti freeze is required to protect the absorber in a concentrator system whereas the entire solar energy collection surface requires anti freeze protection in a flat plate collector

Disadvantages

• Out of the beam and diffuse solar radiation components, only beam component is collected in case of focusing collectors because diffuse component cannot be reflected and is thus lost.

• In some stationary reflecting systems it is necessary to have a small absorber to track the sun image; in others the reflector may have to be adjustable more than one position if year round operation is desired; in other words costly orienting systems have to be used to track the sun.

• Additional requirements of maintenance particular to retain the quality of reflecting surface against dirt, weather, oxidation etc.

• Non –uniform flux on the absorber whereas flux in flat-plate collectors in uniform.

• Additional optical losses such as reflectance loss and the intercept loss, so they introduce additional factors in energy balances.

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