

Unit-2: Solar, Thermal, Energy

Solar Thermal Energy

Solar Radiation - The term solar radiation usually refers to Electromagnetic waves; in other words light. Solar Radiation comes in three types - visible light, infrared light & Ultraviolet light. It travels from sun to Planet Earth.

Example :- Radio waves, X-rays, Gamma Rays.

Properties - 1. Transmission \rightarrow May be transmitted through object.

2. Reflection \rightarrow object may reflect the solar energy.

3. Absorption \rightarrow object may absorb it.

Types of Solar Radiation \rightarrow There are two types

1. Terrestrial Solar Radiation \rightarrow It is derived from the Latin words *terrestris* means Earthly. Solar Radiation that reaches Earth's surface after passing through Earth's atmosphere is called Terrestrial Radiation.

2. Extraterrestrial Solar Radiation → It is derived from the latin words Extra means Outside. It is the measure of solar radiation that would be received in the absence of atmosphere.

-1- Terms Used in solar Radiation -1-

1. Beam or Direct Radiation (I_b) Reflected back to space
 2. Diffuse Radiation (I_d)
 3. Total Radiation (I_T)

$$(I_T = I_b + I_d)$$
 4. Air mass (m_a)
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m_a = Path Length of Beam Radiation through atmosphere
length of Path when sun is at our head on zenith

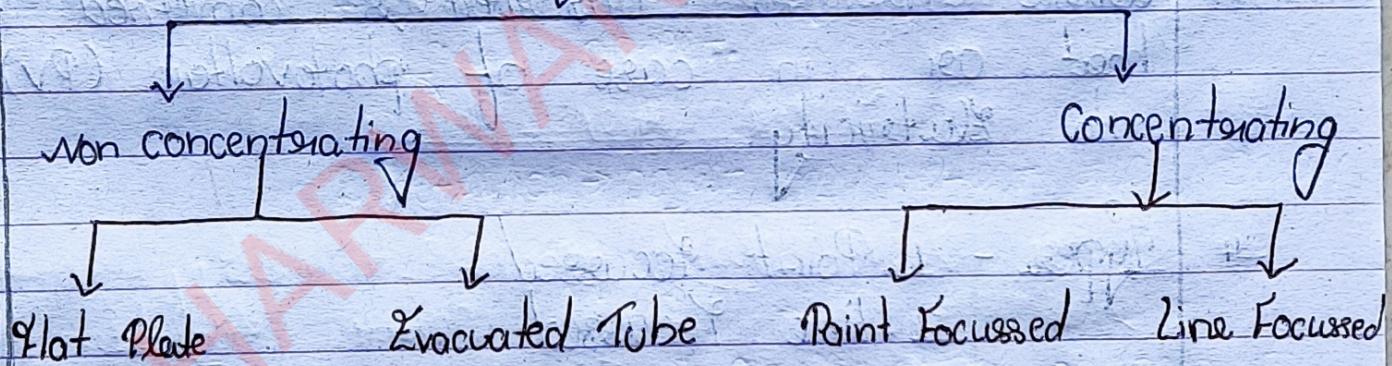
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Solar Collectors

1. Solar collectors are used to collect the Solar Energy & convert this Energy into Thermal Energy by absorbing them.
2. This Thermal Energy is further used for heating a collector fluid such as Water, Oil or Air etc.

-i- Solar collector -i-



1. Non Concentrating Collector :-

Non concentrating collector have the surface area which absorbs the heat from the Sun & transfers it to the working fluid.

-i- Types - There are two types → 1. Flat Plate collector
2. Evacuated tube collector

Merits - 1. Fuel Cost is free.
2. Free Energy of the sun is directly used.
3. Pollution free.

Demerits - 1. Little costly
2. The installations requires space.

2. Concentrating Collectors -

A solar collector that uses reflective surfaces to concentrate sunlight onto a small area, where it is absorbed & converted to heat or in case of photovoltaic (PV) devices, into Electricity.

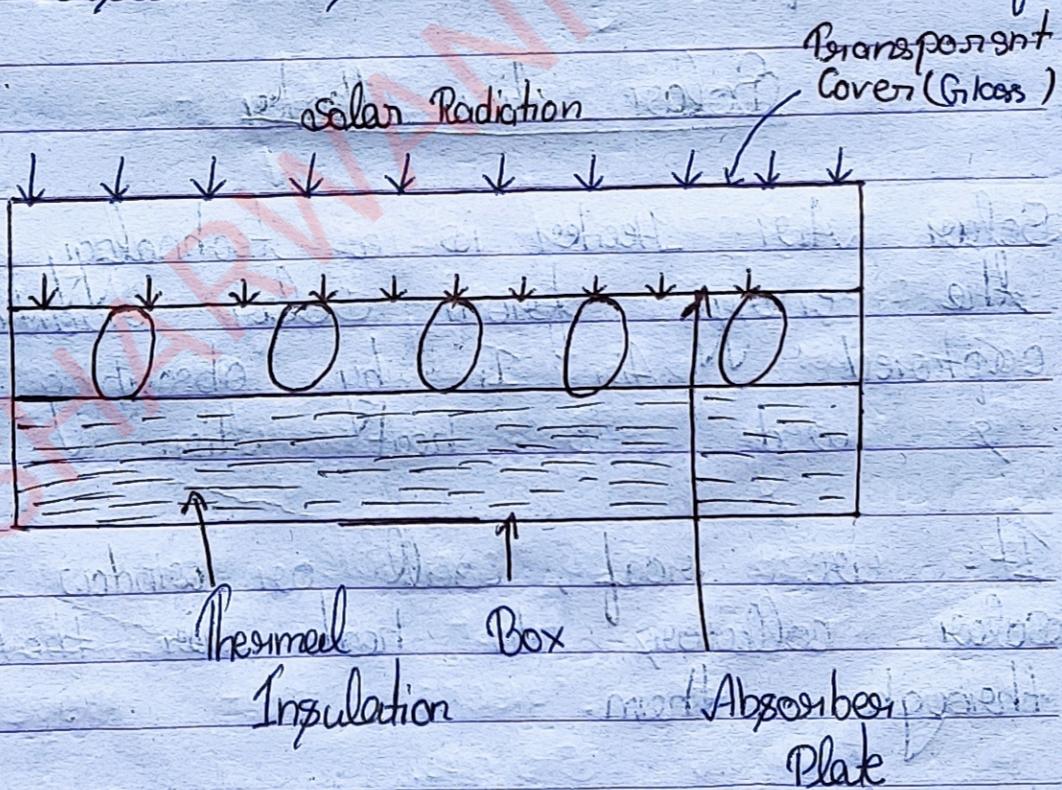
Types - 1. Point Focussed
2. Line Focussed

Merits - 1. No Fuel cost
2. No Pollution & Global warming Effect

Demerits - 1. High Cost
2. Wildlife Effect

-1- Flat Plate Collector :-

1. Principle of conversion of solar energy into heat :-
 2. Definition -
- (i) It is simplest in design & it is most important part of Solar Thermal Energy system.
- (ii) In this Collector both direct & diffuse radiation are absorbed & converted into useful Heat.



-1- Components -

1. Transparent Cover
2. Absorber Plate

- 3. Insulation
- 4. Tubes

-i- Advantages -I-

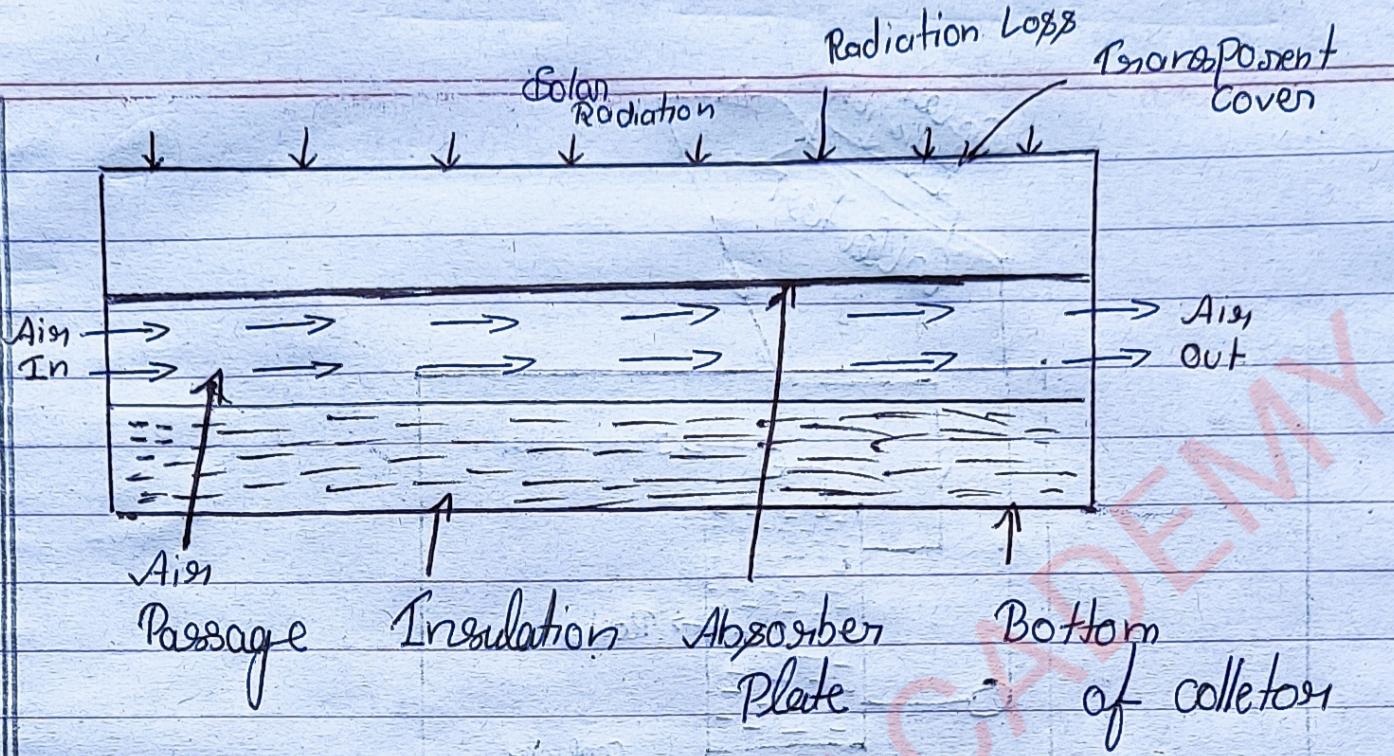
- 1. Absorbs both direct & diffuse radiation.
- 2. Low Cost & requires less maintenance.

-I- Disadvantages -I-

- 1. Heavy in weight
- 2. Low temperature is achieved.

Solar Air Heater

- 1. Solar Air Heater is a technology in which the energy from solar radiation is captured by Air by absorbing medium & used to heat Air.
- 2. It uses roof, wall or window mounted solar collectors to heat air that passes through them.
- 3. A solar air heater is essentially a flat plate collector with absorber plate.

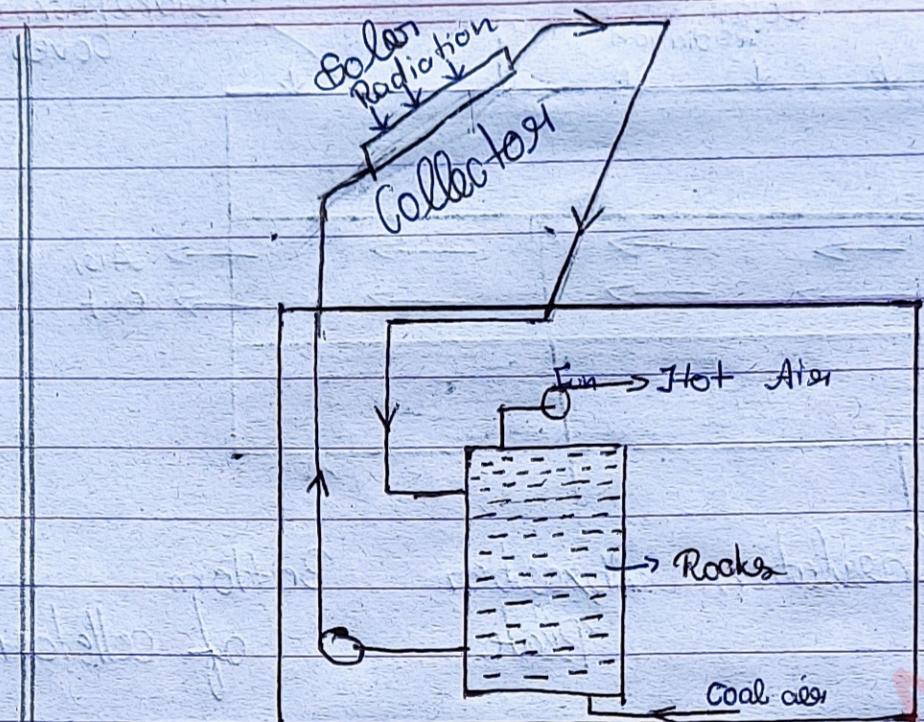


4. It is a transport cover system at top & insulation at the bottom.
 5. The whole assembly is enclosed in a sheet metal container.

Thermal Energy Storage for Solar Heating :-

~~Thermal Energy storage for space heating :-~~

1. The solar energy is utilized for space heating in winter or in cold countries.
 2. The different methods adopted for space heating are passive & Active method.



Active Space Heating
By Solar Collector.

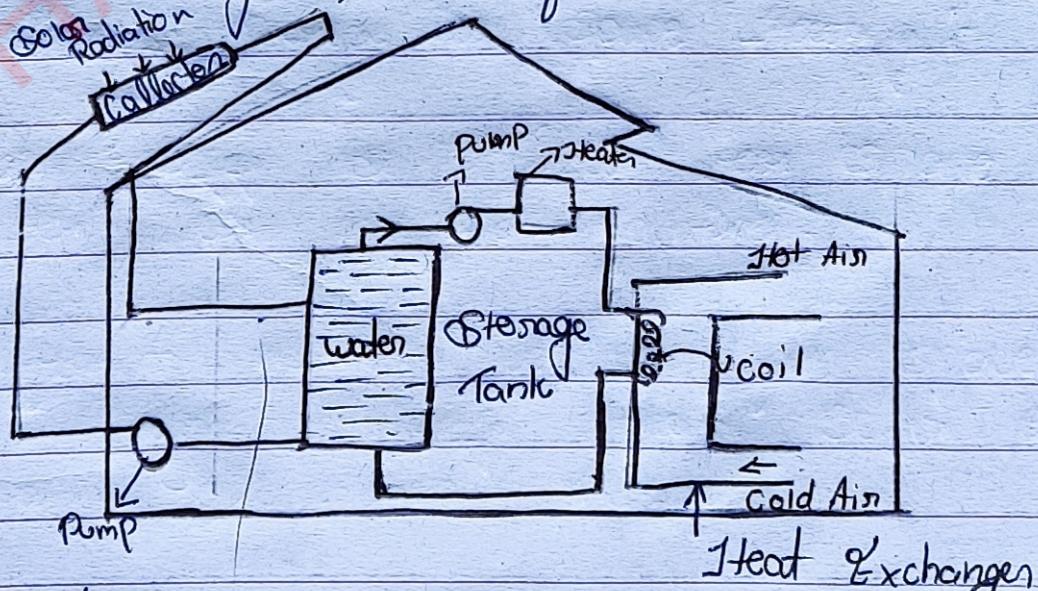
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Active Space Heating -

1. Active method of space heating utilizes Collectors (air heater) through which the cold air is circulated, gets heated & supplied to living space directly.
2. To utilize this available heat in night, hot air is first circulated through tank packed with rocks that act as a thermal storage.
3. When there is no sunshine or during night the cold air from rooms flows after heating

get distribution in the living rooms.

1. The water heating arrangements is provided through collectors placed at top of roof.
2. The Hot water stored in a tank is circulated through the tubes attached to black absorber surface of collector.
3. Heat is delivered to living space by a fan blowing the room air through the heating coil in heat Exchanger through which hot water in storage tank is circulated in coils.
4. The Heat is extracted by re-circulated air through exchanger & transferred to the room.



- Active space Heating By water Collector -