NEED FOR SOLAR COOKER

- Half the world's population burn wood or dried dung to cook food.
- Wood cut for cooking purposes contributes to the 16 million hectares of forest destroyed annually.
- People are exposed to indoor air pollution as a result of burning solid fuels for cooking and heating.
- Nearly 1.2 billion people, do not have access to clean drinking water.
- Over 1 million children die yearly because of un-boiled drinking water.

COOKING PRINCIPLE

- Solar cookers are passive solar devices.
- Sunlight is converted to heat energy which is retained for cooking.
- Solar cookers utilize the simple principles of reflection, concentration, absorption and greenhouse effect to convert sunlight to heat energy.
- The steps involved in the solar cooker are concentrating , capturing and converting the solar energy.
- Clean cooking technology

CLASSIFICATION

1. Direct Type : Use some solar energy concentrator to focus sunlight onto an area.

   Eg: Parabolic solar cooker

2. Indirect Type: A box covered with transparent material like glass. Employs greenhouse effect for cooking

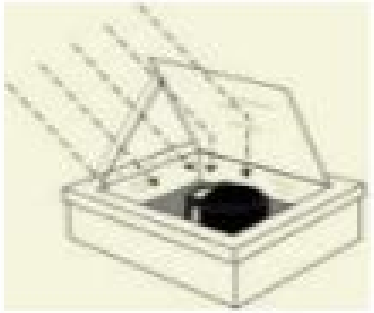
   Eg: Solar box cooker

3. Advanced Type: The cookers use either a flat piece or focusing collector, which collect the solar heat and transfer this to the cooking vessel.

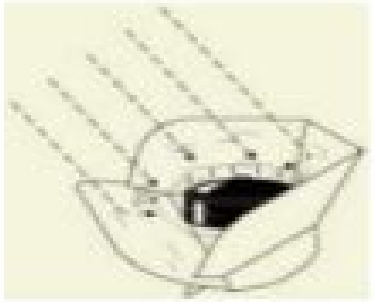
   Eg: Thermal storage solar cooker

Common Types Of Solar Cookers

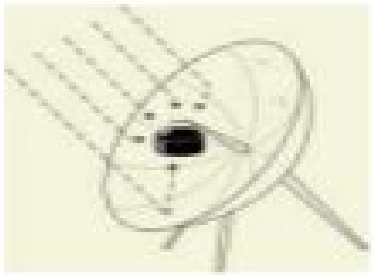
- Box Cooker



- Panel Cooker



- Parabolic Cooker



Solar Box cooker

- Most common and inexpensive type of solar cookers.
- Employs greenhouse effect.
- Most popular and easier to build.
- Reach temperatures up to 140 – 150 °C
- Advantage of slow, even cooking of large quantities of food.

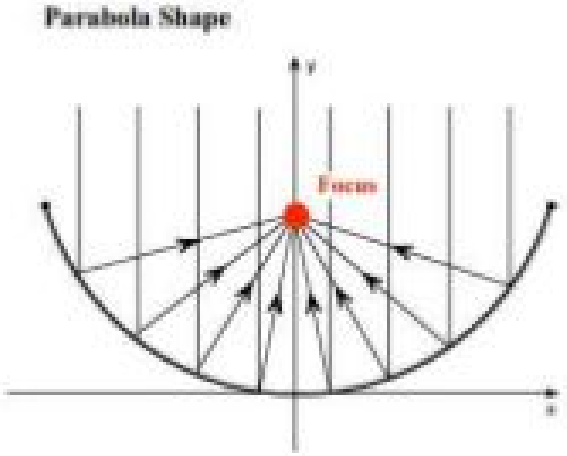
WORKING

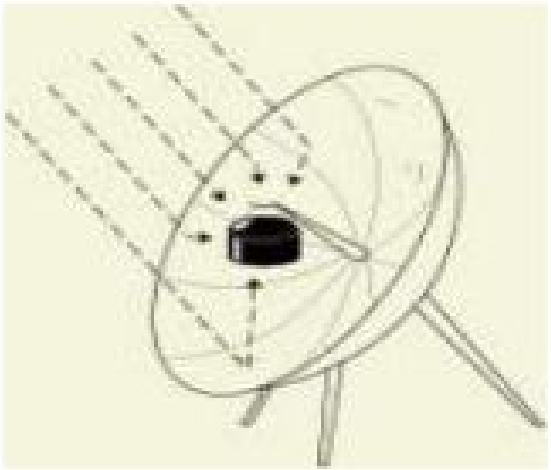
- Consists of an insulated box with a glass or a plastic window.
- The window acts as a solar energy trap by exploiting the greenhouse effect.
- Solar radiation passes through the window, and is absorbed by the walls, the bottom of the cooker and the cooking utensils.
- To maximise the heating effect, the walls, and outer side of the pots should are painted black

Parabolic Cooker

- Focus a lot of sun energy onto a very small space, using parabolic shapes .
- Works on the principle that when a 3D parabola is aimed at sun , the rays are reflected on to the focus.
- Cooks nearly as fast as a conventional oven
- Costly and complicated to make and use – have to turn frequently to follow the sun

- Consists of a large parabolic reflector and cooking pot holder
- When the reflector surface is aimed at the sun , the rays falling on the parabolic surface converges to the focus of the parabola.
- The cooking pot is placed at the focus of the reflector.
- The pot surfaces are blacked to improve the absorption.



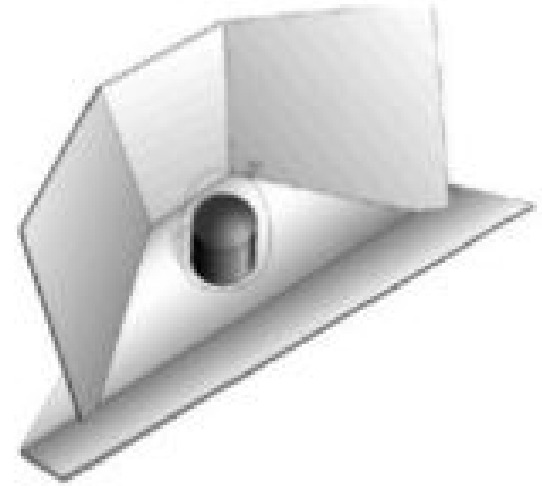


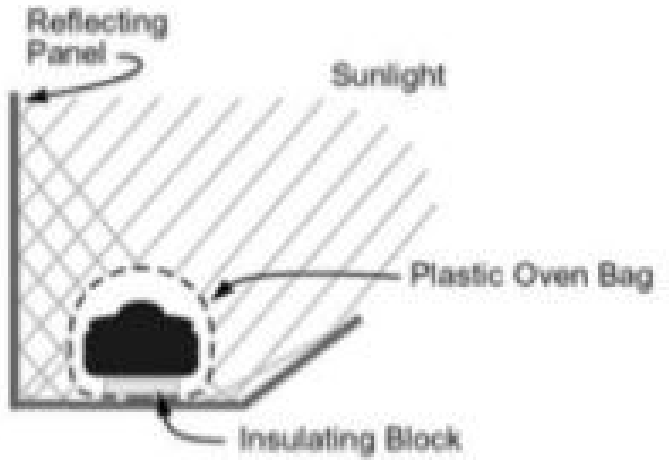
Panel Cooker

- Cooking pot is enclosed by a panel of reflectors.
- Sunlight is reflected off of multiple panels onto a pot under a glass lid or in a bag .
- Can be built quickly and at low cost
- Many different varieties
- Popular with relief agencies.

WORKING

- It incorporates elements of both parabolic and box solar cookers.
- The reflective panel directs sunlight onto a dark colored pot.
- The pot is enclosed in an insulating shell such as high temperature cooking bag or an inverted bowl.
- Can attain temperatures in the range of 95 – 125 ^{o}C.



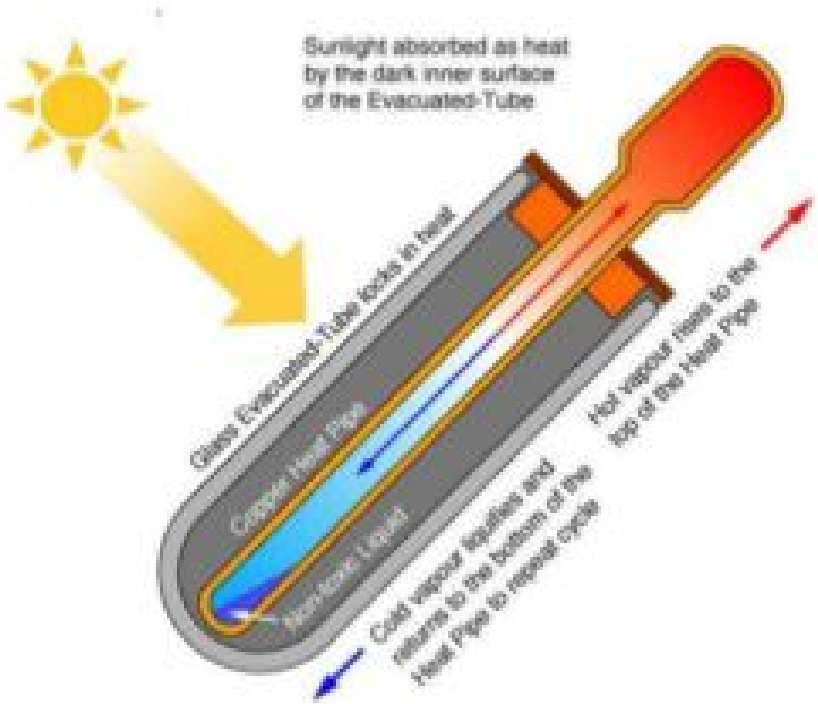


TYPE	ADVANTAGES	DISADVANTAGES
SOLAR BOX COOKER	USE BOTH DIRECT AND DIFFUSE RADIATION EASY AND SAFE TO USE REQUIRE LITTLE INTERVENTION BY USER HIGH ACCEPTANCE ANGLE	WIDELY DIVERGENT THERMAL PERFORMANCE
PANEL COOKER	BETTER PERFORMANCE THAN BOX COOKER	RELIES MORE ON REFLECTED RADIATION
PARABOLIC COOKER	CAN ACHIEVE HIGHER TEMPERATURES. HIGH EFFICIENCY	SAFETY PROBLEMS CONSTRUCTION IS RELATIVELY DIFFICULT LOW ACCEPTANCE ANGLE REQUIRES USER ATTENTION

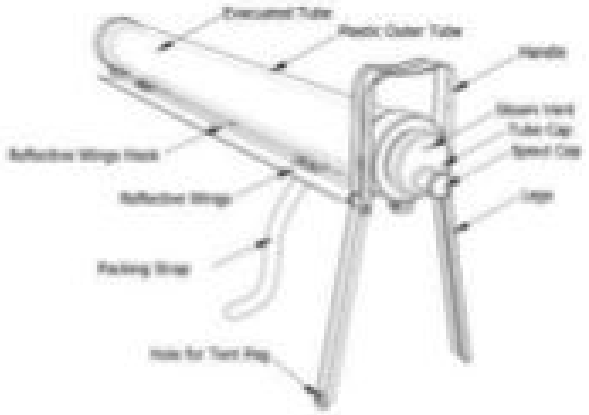
VACCUM OR EVACUATED TUBE SOLAR COOKER

- The design is a simple flat plate collector housed in an evacuated glass tube
- The tubes are made from a type of glass called Borosilicate, which is resistant to thermal shock
- Borosilicate glass has the characteristic of being very strong and also has excellent light transparency.

- It consists of two concentric glass tubes with vacuum in between.
- The outer tube is transparent while the inner is coated with Aluminium nitride for better absorption.
- The evacuated glass tube tube receives the solar rays that pass through and is absorbed by the inner lining.



- The combination of the highly efficient absorber coating and the vacuum insulation means that the coating can be well over 200° C.
- Due to the presence of vacuum , the heat losses will be negligible
- A reflector is provided for concentrating sunlight onto the tubes.
- A tray is provided inside the glass tube for cooking purposes.



Community Solar Cooker

- Cook using solar energy within the kitchen itself.
- Due to high temperature and power at focal point, the cooking rate is significantly higher.
- Cooking for about 40 to 50 persons is possible with 7 sq. m,. size dish cooker.
- The most popular version is the scheffler community kitchen.

HELIOSTAT

- A device that reflects sunlight in a fixed direction as the sun moves is known as a Heliostat.
- The heliostats are mirrors with solar tracking on two axes and capable of concentrating the reflected solar radiation on a focal point.
- Heliostats are generally made from iron glass
- Scheffler heliostats are used for community solar cookers.

Stored Energy Solar Cooker

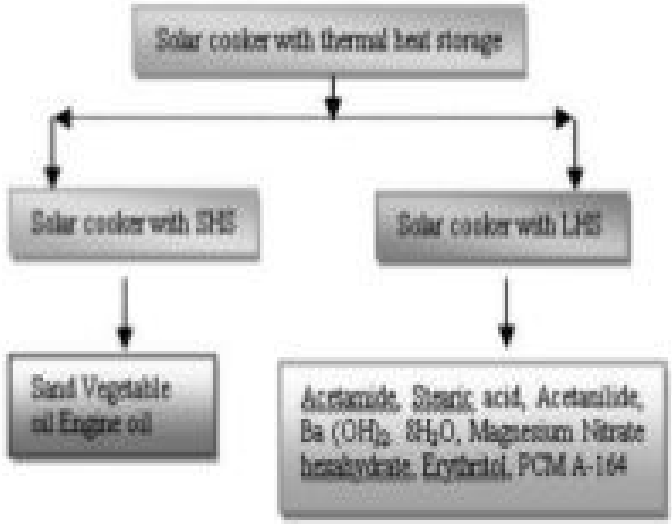
- The major drawback of solar cooker is that cooking cannot be done when solar energy decreases.
- Stored energy solar cooker stores the reflected solar energy to be used when sunlight is not available.
- It is an advanced type solar cooker.
- PCM's (phase change materials) which have high latent heat are usually used for storage of energy.

THERMAL STORAGE

Two methods are available for storage of thermal energy

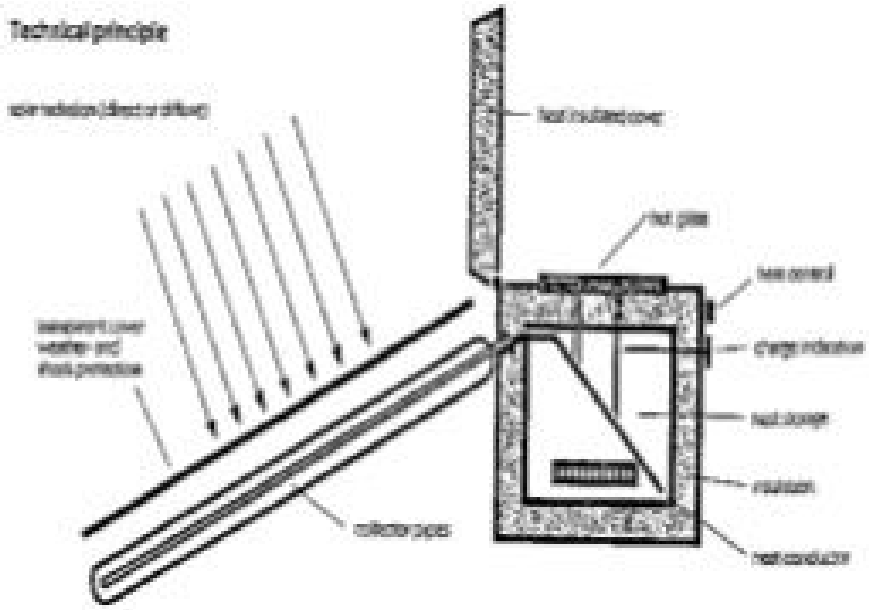
1. Sensible heat storage : Energy is stored or extracted by heating or cooling a liquid or solid without change in phase. The choice of substance depends on the temperature range. Water is used for temperatures below 100 c and refractory bricks for temperatures around 1000 c . These are simpler in design compared to latent heat storage systems but they are bulky in size. Also they cannot provide heat at a constant temperature

2. Latent heat storage: They store heat by change of phase of material. Due to the phase change they can store large amount of heat at a constant temperature. A PCM(phase change material) is used for storage of heat energy. Unlike the SHS method, the LHS method provides much higher storage density, with a smaller temperature difference between storing and releasing heat.



WORKING

- Solar rays penetrate through the glass covers and absorbed by copper tubes.
- The other end of the copper tubes is connected to storage tank.
- The storage tank contains a refrigerant . Refrigerant absorbs the energy from the tubes and stores it into a tube of containing PCM.
- This stored energy is used to maintain the temperature of the cooker when the sunlight is not available.



ADVANTAGES

- It is a renewable energy
- The solar cooker requires neither fuel
- it preserves more of the natural nutrients of the foods by cooking at slower and lower temperatures
- Saves a lot of firewood
- Can be used in areas where fuel and firewood are not available

DISADVANTAGES

- It is not continuous.
- It cannot be used during rainy season or cloudy conditions.
- Performance could be affected by strong winds
- Time required is higher than conventional cooking methods.