SOURCES OF ENERGY Solar and Geothermal Energy

SOLAR ENERGY:

The sun is the primary source of energy for all living beings on the earth. It provides all of us heat and light. The energy generated by the sun is the result of reaction called nuclear fusion, occurring continuously in the interior part of the sun. Hans Bethe, a physicist proposed that the enormous release of energy from the sun is due to the fusion

(combination) of four hydrogen atoms to yield a single helium atom ($\frac{4}{2}$ He). For this discovery he was awarded the

1967 Noble prize in Physics. The sun emits energy in all directions in space.

Solar energy in trapped by plains, plateaus, mountains, rivers, lakes, oceans and ponds. Plants use solar energy to manufacture food by photosynthesis and also solar energy is the source of wind storms, rain, snow fall & ocean waves.

It is the perennial (forever) source of energy.

This perennial source of energy has some features:

(i) It comes to earth surface in a very diffused form.

(ii) Upper atmosphere gets 1.3 KJ of energy per second per square meter of this only 47% i.e., approximately 0.64 KJ energy reaches per second per square meter on earth's surface.

(iii) Moreover, this amount of energy is not available uniformly and keeps changing every day at a place and place to place during a day.

(a) Composition of Solar Energy (Sunlight):



(I) Ultra violet rays:

The invisible rays whose wavelength is shorter than that of the visible violet light are called ultra violet rays. We can detect these rays by using a photographic film or a fluorescent paper because they darken the photographic film just like ordinary light rays. They are used to kill bacteria in food stuff and drinking water. Too much ultra-violet radiation is dangerous for our health due to its ionising effect and can cause skin cancer.

(ii) Visible light:

The visible rays whose wavelength range from 400 nm (in violet) to 700 nm (in red) are called visible light. The visible apart of the sunlight consists of seven different wavelet, each wavelength corresponding to a different colour. Thus the visible part of the sunlight consists of seven different colours.

(iii) Infra - red rays:

The invisible rays whose wavelength is longer than that of the visible red light are called infra-red rays. They can heat the object on which they fall. About one-third of the solar energy consists of infra-red rays. They ca be detected by its heating effect, by using a thermometer. Every hot object emit infra-red rays. They are used to get relief from body aches.

(b) Uses of Solar Energy:

- (i) Solar cooker absorb solar energy and cook food,
- (ii) Solar water hearers are used for heating water.
- (iii) Solar cell convert solar energy into electricity to run watches, calculators and in spaceships for various experiments.
- (iv) Solar energy is absorbed by green plants to make their food by photosynthesis.
- (v) Solar energy is used for drying clothes and food grains.
- (vi) Solar energy is used for making salt from sea water.

(c) Advantages of Solar Energy :

- (i) It is inexhaustible and renewable as it producing continuously in the core of sun by nuclear fusion of Hatoms.
- (ii) Its quantity is unlimited and is available in all parts of the world in abundance.
- (iii) It does not cause any pollution.
- (iv) It can be put to practical appliances.

(d) Limitations of Solar Energy :

- (i) It is not available at night.
- (ii) It is not available uniformly in all parts of world.
- (iii) Solar energy received by the earth is quite diffused and in scattered form and hence only a part of it is utilized.
- (iv) It is not available at constant rate due to clouds, fog, mist, haze, winds etc.

(d) Direct and Indirect Harnessing (or Collection) of Solar Energy :

(i) Direction utilization of solar energy can be done by collecting the heat radiation on reflecting these by plane mirrors on to black boxes containing uncooked food (in solar cooker) and for heating water in solar heaters. These rays can be converted into electrical energy as in solar cells.

(ii) Indirect utilization of solar energy can be done by first converting solar energy into chemical energy as in biomass of plants. Heat energy of sun can be utilized in sea waves (ocean thermal energy) and into energy of winds etc.

(f) Solar Heating Devices :

These are the devices which can collect and store heat obtained from solar energy. These are used for heating and cooking purposes. Solar heating devices are designed in such a way so that these can make maximum utilization of solar heat radiations. It is done by adopting following procedure :

(i) Concentration of solar energy of using reflectors :

For moderate heating sun rays are reflected by using plane mirrors, as in solar cookers and solar water heaters. For high temperature, sun's energy is concentrated using concave mirrors as reflectors.

(ii) Black paint :

Since black bodies are good absorbers as well as good radiators of heat, hence black paint is used to absorb and store heat radiations in large quantity by using large surface area.

(iii) Glass - sheet cover :

Glass sheet cover is used to protect the hot infra red rays of solar energy from escaping the body of black box. It allow the IR radiations (of shorter wavelength) to enter the box of solar heating device and do not allow IR radiations (of longer wavelength) to escape from the solar heating device. Hence more heat is retained by solder heating device for long time.

(A) Box type solar cooker:



Solar cooker is a device used for cooking food with the help of solar energy. A box is made of a non - conducting material like plastic or fiber glass and painted black from inside is used for making the solar cooker. The cooker is placed in the sunlight and the position of the reflector is adjusted in such a ways that a strong beam of light falls over the cooker top. These rays pass through the transparent glass sheet, therefore the box and the containers absorb maximum amount of infra red radiations from the sunlight falling on it. As a result the temperature inside the box rises to about 100^{0} C to 130^{0} C.

(B) Spherical reflector type solar cooker:

In this type of solar cooker, there is an insulated metal box, painted black from inside. A spherical reflector is used here (in place of plane mirror) Because a very high temperature is required, the spherical reflector is either a concave reflector or a parabolic reflector. The sunlight falling on the surface of spherical reflector get concentrate to one point. This will produce a lot of heat at that point & temperature in that region will become very high, therefore in this type, an utensil is placed at this point. Since a high temperature can be produced, so it can be used for making chapattis and for frying purposes.

Difference between box – type & spherical reflector type solar cooker			
Box – type solar cooker		Spherical reflector type solar cooker	
1	A plane mirror reflector is used.	1	Spherical reflector is used
2	In a box type solar cooker, comparatively	2	Quite high temperature is produced in
	low temperature is produced		the spherical reflector type solar cooker.
3	It cannot be used for making chappaties	3	It can be used for frying and making
			chappaties
4	Used for cooking food requiring slow	4	Used for cooking food requiring strong
	heating.		heating.

(C) Solar cells:

Solar cells is a device which converts solar energy directly into electricity. Energy radiated from the sun also contains light energy. So solar cells are also known as photo voltaic cells. The process of generating electricity directly from sunlight is referred to as a photo voltaic effect. The photo voltaic effect occurs when solar radiation strikes certain sensitive material directly and results in the flow of electrons. It was found that when 0.6% of the solar energy falling on the selenium layer got converted into electricity. With the advancement in the field of semiconductors, the solar cells made from these semiconductors can convert 10 to 15% of solar energy into electricity.



(a) Semi-conductors:

Semi-conductors are those substances which have very low electrical conductivity. Under ordinary conditions, semi-conductor materials conduct only a small amount of electric current. But if certain impurities are added to semi-conductor materials then their electrical conductivity increases considerably. Semi-conductors are neither good conductor of electricity nor they are completely insulators. The process of adding impurity is called doping/ The material (semiconductors) doped with boron has an affinity to attract electrons and is termed as p-type (acceptor) semiconductor. The phosphorous doped silicon material, which has a surplus of electrons, is termed as n-type (donor) semiconductor. When solar energy falls on semi-conductor material, even then their electrical conductivity increases.

(b) Conduction of solar cell:

It is constructed usually from silicon & gallium. Its conductivity increases when light falls on them. Therefore in a solar cell, the pieces (usually wafers) of semi conducting materials containing impurities are so arranged that when light falls on them then potential difference is produced between two regions of the semi conductor. It has been observed that a solar cell of about 4 cm^2 may produce potential difference of about 0.4V to 0.5V and generate and current of 60 mA. A large number of solar cell joined together in a definite pattern can provide much higher power for many use. The group of solar cell is called solar cell panel.

(c) Solar cell panel :

When solar cells are arranged side by side, connecting each other in such a way that total potential difference and the total capacity to provide electric current is much increased the arrangement is called solar cell panel. The electric power required for the working of artificial satellites in outer space, street lighting in remote areas and running of irrigation water pumps in far-off areas obtained with the help of solar cell panels. In a solar cell panel hundreds of solar cells are joined together, the electricity produced by this solar panel is stored in battery. This battery runs an electric motor and finally the motor drives the water pump, which pump out the underground water. The various solar cells in a solar cell panel are joined together by using connecting wires made of silver. This is because silver metal is the best conductor of electricity having very low resistance. The use of silver for connecting wires of other metals ware used in solar cell panel, then a substantial apart of the electricity generated by it could be lost in overcoming the resistance of such connecting wires.



(d) Uses of solar cell:

(i) Solar cells are used for providing electricity in artificial satellite and space probes.

(ii) In India, solar cells are behind used for street lighting, for traffic, signals, for operating water pump and for running radio and television sets i remote areas.

(iii) Solar cells are used for providing electricity to "lighthouses" situated in the sea and to the off - shore oil drilling ring platforms.

(iv) Solar cells are used for operating electronic watches & calculators.

GEOTHERMAL ENERGY:

Geothermal energy is the heat energy of hot rocks present inside the earth. This heat can be used as a source of energy to produce electricity. Geothermal energy is one of the few sources of energy that do not come directly or indirectly from solar energy. The places where very hot rocks occur at same depth below the surface of earth are called 'hot spots' and are sources of geothermal energy.

The geothermal energy is harnessed as follows:

- (i) The extremely hot rocks present blow the surface of earth, heat the underground water and turn in into steam. As more and more steam is formed between the rocks, it gets compressed to high pressures. A hole is drilled into the earth and the hot rocks comes up through the pipe at high pressure. This high-pressure steam rum the turbine of a generator to produce electricity.
- (ii) Large rocks are present in the underground rocks, which allow steam and hot water to go up. The steam & hot water gushing out of the ground are a kind of natural geyser. This steam is then used to turn turbines and generated electricity and the hot water is used to cook food.



Advantages of geothermal energy

- (a) Geothermal plants can operate round the clock, unlike those based on solar and tidal enryg.
- (b) Geothermal energy is almost pollution free.
- (c) It is chirper to run a geothermal plant than a coal-based plant.
- (d) The source of energy is free and renewable.