

SOLAR ENERGY AS AN ALTERNATIVE SOURCE OF ENERGY

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INTRODUCTION

The sun has been a constant source of energy for millions of years and shall continue to be so for millions of years more. The sun's energy is produced in it by the process of thermonuclear fusion. The energy from the sun consists of electromagnetic radiation ranging from short wavelength, X-rays to long wavelength radio waves, with about 99% of it in the form of light, infrared and ultraviolet. The earth's upper atmosphere receives about 1.38 kilojoules (kJ) of energy per second per square meter. It is interesting to know that the earth receives more energy from the sun in just one hour than the world uses in a whole year!

The entire energy falling on the upper atmosphere does not reach the earth's surface. About 30% of this energy is reflected by the atmosphere into the space. The remaining part travels towards the earth's surface. A part of it is absorbed by water vapour, ozone, dust and carbon dioxide present in the atmosphere. Only about 47% of the incident energy reaches the earth's surface. Even then it is sufficient to end all our energy problems if we can find a way to harness it.

As the deposits of fossils fuels such as petroleum likely to be exhausted in short time, the crisis of energy has now become a heated topic. In these circumstances, scientists are working hard to find ways to use solar energy in more efficient ways.

HARNESSING SOLAR ENERGY

In recent years, a number of devices have been developed which use solar energy for various useful purposes. These can be divided in two groups:

- (a) Those using the heat energy of the sunlight
- (b) Those which convert the energy of the sunlight into electricity

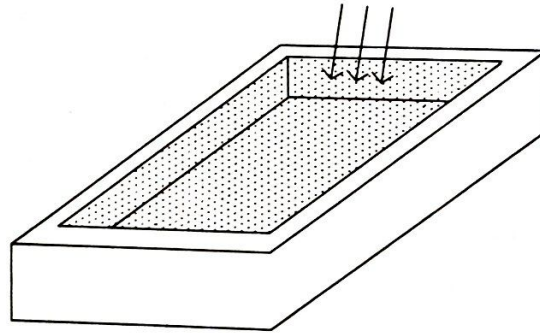
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SOLAR HEATING DEVICES

A solar heating device is that which allows collection of a large amount of heat from the sunlight in a given region and restrict the loss of heat from the region.

Any object placed in the sun will absorb heat from it. Absorption increases if the surface of the body is painted black. This principle is used in solar heating devices.

A simple solar heating device can be constructed by taking a box made of a poorly conducting material, painting its inner surface black and closing it at the top by a glass sheet. The bottom surface receives most of the heat and is the main collector of sunlight. In such an arrangement loss of heat by conduction is minimized because the walls are made of poorly conducting materials. Convection loss is reduced because the box is closed and air inside can not take the heat out of the box. Radiation loss is also reduced because large part of the heat radiated by the blackened surfaces is reflected back into the box by the glass top.



When the sunlight falls into the glass top from outside, the glass top allows the radiation to go into the box. Only a small part of the radiation is reflected. But when radiation from inside the box falls on the glass top, the top reflects a large part back into the glass top. The glass acts like a traffic controller allowing only one-way traffic. The efficiency of the solar heating device can be increased by putting a plane mirror at suitable inclination. This increases the amount of sunlight going into the box. The solar heating devices are of the following types:

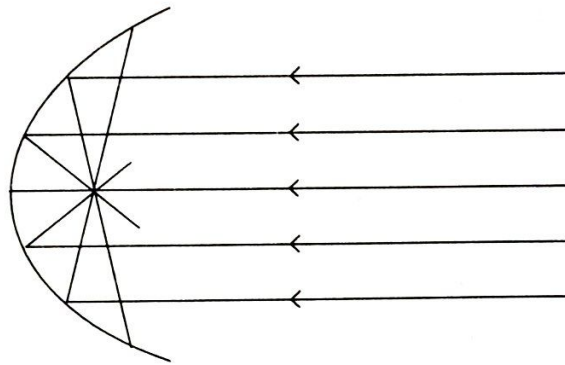
Box type solar cooker

The device described above can be used to cook food and it is called a box type solar cooker. The temperature inside the box becomes 100°C to 135°C in about two to three hours. This time depends on the intensity of the sunlight. In such a cooker one can cook food items which require slow heating. Baking and frying are generally not possible in a box type solar cooker.

Reflector type solar cooker

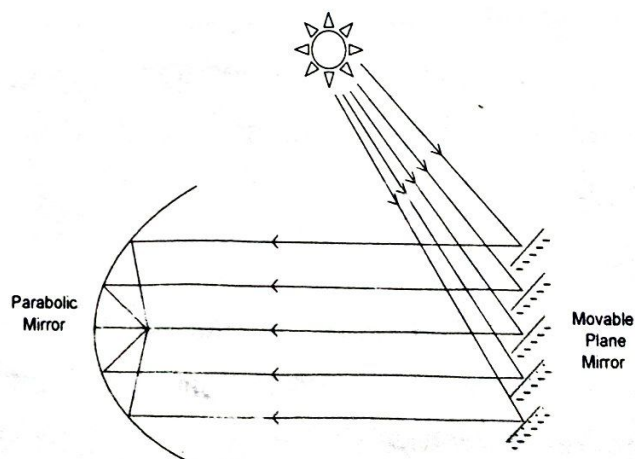
The principle of a reflector type solar cooker is the same as that of heating by a magnifying glass. In this design, suitable mirrors are arranged in such a way that they focus the sunlight collected over a large surface area to a small region. Because of this concentration of the sunlight, high temperature is produced in that small region. A spherical mirror will work for a small cooker, but a parabolic mirror will be better for a big cooker.

In even larger reflector type heating devices, a large number of small plane mirrors are arranged side by side, with different orientations, to focus the sunlight to the desired area. In this design, very high temperature can be obtained. So in this type of cooker one can fry egg and bake chapattis.



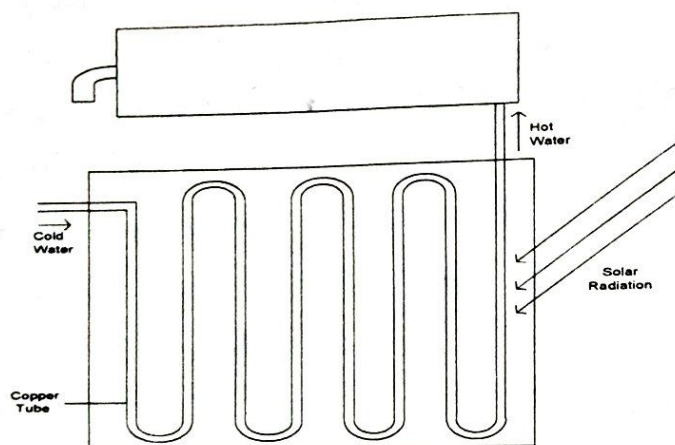
Solar furnace

In solar furnace, a large number of movable plane mirrors are used to reflect the sun's rays to a large parabolic mirror. The parabolic mirror focuses the rays to a small area, producing intense heat. Solar furnace can be used to heat water to produce steam. This steam can be used to rotate turbines connected to the electric generator. Solar furnaces are also used to heat materials to high temperatures and study their properties at these high temperatures.



Solar water -heater

In solar water- heater, water is passed through a copper tube having large number of turns. The tube is painted black from outside and is exposed to the sun. As the water travels a long distance in the tube it gets enough time to absorb heat and the water becomes hot. This hot water can be collected in the container.



Solar power plant

Solar heating systems can also be used to generate electricity. Water in a boiler can be put at the focus of a reflector type solar heating device or a solar furnace. Solar energy will convert water into steam. The steam can be used to run a steam turbine connected to a generator which produces electricity.

SOLAR CELLS

A device which converts solar energy directly into electricity is called a solar cell. The first practical solar cell was constructed in 1954 which had an efficiency of 1% in converting solar energy into electrical energy. Because of low efficiency, the solar cell did not get importance for a long time. However, as the need increased, scientists made efforts to increase the efficiency and succeeded to a large extent. Today we have achieved a stage where up to 25% of the solar energy can be converted into electricity.

Semiconductors in solar cells

Silicon, germanium and several alloys are semiconductors. The semiconductor has conductivity in between those of good conductors and insulators.

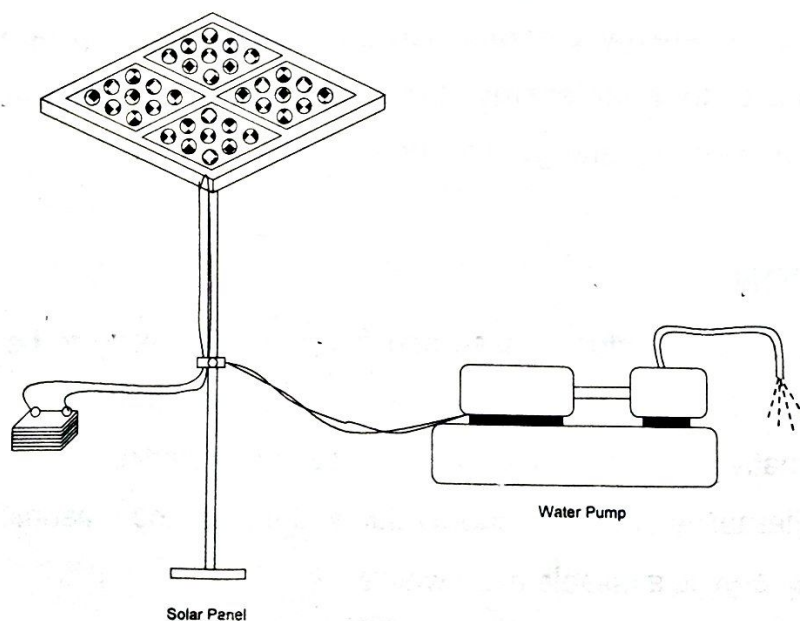
A very small amount impurity added to a semiconductor can also increase its conductivity by a large amount.

Solar cells are usually made from doped semiconductors. Wafers of doped semiconductors are so arranged that when sufficient light falls on the arrangement, potential differences are developed and energy is stored as electricity. This forms a solar cell. The power of the solar cell depends on the surface area. Larger the surface area, more solar energy will be collected and more will be the power. A single solar cell of area 0.4 cm^2 can usually develop a potential difference of about 0.4 to 0.5 volt and supply a current of about 60 milliamperes (mA). The efficiency of solar cells made from semiconductor is generally about 10-15%.

Solar Panels

In solar panel, a number of solar cells are arranged side by side. They are connected to each other in such way that the total potential difference and the total capacity to provide electric current become large. Such a solar panel can be used for lighting, operating water pumps, operating TV and radio receivers etc.

The advantage of solar panel is more in remote and isolated areas where usual energy sources are not available. The greatest use of solar panels is to provide electric power to satellites. In several villages in Nepal, solar panels are



being used to charge rechargeable batteries during the day. At night, these batteries provide electric power for lighting etc.

SOLAR ENERGY PROGRAM IN NEPAL

Nepal has an abundant solar resource and evenly distributed throughout the country. Nepal has more than 300 sunny days in a year and the average insolation in Nepal is around 4.5kWh/m²/day at optimum tilt. It has come out as a viable option to meet electric energy demand, in non-electrified rural areas of Nepal. Solar energy has been using in Nepal in the following sectors:

- Rural Electrification (lighting, TV etc.)
- Telecommunication
- Water pumping
- Vaccine refrigerator
- Powering the Navigation equipment
- Powering computers in offices and schools at remote areas

Government of Nepal has been providing subsidy in the following solar energy related projects in remote areas:

- Solar Home System (SHS)
- Solar Cooker
- Solar Dryer
- Solar Water Pump (SWP)

Solar energy has thus been very important source of energy in the Nepalese perspective. Solar energy program has got serious attention in Nepal. With the recent emphasis on solar energy, there are various opportunities for economic development and solving energy crisis problems.

CONCLUSION

As the store of natural gases and fossil fuel are likely to be exhausted, the cost of energy continues to increase and, people around the world are looking for low cost alternative sources of energy. In these circumstances, the solar energy may be the best alternative source of energy due to the following reasons:

- (a) Solar energy is available everywhere
- (b) Solar energy is available in plenty

- (c) Solar energy can be used for cooking, heating, operating machines, running power plants to generate electricity, providing electric power to artificial satellites etc.
- (d) Solar energy does not cause any environmental pollution
- (e) Solar energy technology continues to fall in price
- (f) Solar energy is highly reliable, safes, clean and quiet to operate
- (g) Solar energy is flexible and can be expanded at any time to meet electric needs
- (h) Solar energy allows people to be completely independent once it has been installed.

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