

SOURCES OF ENERGY

Gist of the Lesson:

Conventional Sources of Energy are: Fossil fuels, kinetic energy of flowing water, potential energy of water at a height, wind energy, biomass fuel.

These fossil fuels are non renewable sources of energy and cause environmental problems due to pollution.

Thermal Power Plants:

- (i) Use coal, petroleum and natural gas to produce thermal electricity.
- (ii) Electricity transmission is very efficient.
- (iii) The steam produced by burning the fossil fuels runs the turbine to produce electricity.

Hydro Power Plant:

1. It is the most conventional renewable energy source obtained from water falling from a great height.
2. It is clean & non polluting source of energy.
3. Dams are constructed to collect water flowing in high altitude rivers. The stored water has a lot of potential energy.
4. When water is allowed to fall from a height, potential energy changes to kinetic energy, which rotates the turbines to produce electricity.

Disadvantages of Hydro Power Plant:

- (i) Highly expensive to construct.
- (ii) Dams cannot be constructed on all river sites.
- (iii) Large areas of human habitation and agricultural fields get submerged.
- (iv) People face social and environmental problems.

Non Conventional Sources:

(1) Bio Mass:

It is the source of the conventionally used fuels that are used in our country. E.g.: Cow dung cakes, fire-wood, coal, charcoal

Bio Gas: It is a mixture of gases produced during decomposition of bio mass in the absence of Oxygen (Anaerobic Respiration). Methane is the major component of bio gas.

Bio Gas Plants- Animal dung, sewage, crop residues, vegetable wastes, poultry droppings, etc. are used to produce Bio gas in Bio gas plants.

(2) Wind Energy:

It can be converted into mechanical and electrical energy.

Kinetic energy of the wind is used in running of wind mills, which are used to lift water, grind grains, etc.

Wind mill

Advantages:

- (i) Eco friendly
- (ii) Renewable

Disadvantages:

- (i) Wind speed not uniform always.
- (ii) Needs a large area to erect series of wind mills.
- (iii) Big amount of investment is needed.
- (iv) Output is less as compared to investment

(3) Solar Energy:

Solar radiations can be converted into electricity through solar cells (photovoltaic cells).

Photovoltaic cells convert solar radiations directly into electricity through silicon solar cells.

Solar cells arrange on a large flat sheets form a solar panel.

Solar cookers are painted black from outside and a large glass plate to trap solar radiations by green house effect.

Advantages of Solar Cookers:

- (i) Eco friendly
- (ii) Renewable
- (iii) Used in rural areas.
- (iv) Retains all the nutrients in food due to slow cooking.

Disadvantages of Solar Cooker:

- (i) Silicon cells are expensive.
- (ii) Solar radiations are not uniform over earth's surface.
- (iii) Cannot be used at night or on cloudy days.

(iv) Cannot be used to make chapattis for frying as these require a temperature of 140C or more. (Maximum temperature of 1000C only can be achieved in a solar cooker)

Other solar devices- Solar water heater, Solar furnace

(4) Geo Thermal Energy:

- (i) Energy harnessed from the heat of the sun is called Geo thermal energy.
- (ii) Magma is formed when this heat melts the rocks. The molten rocks and hot gases are called magma
- (iii) The magma gets collected at some depths below the earth's surfaces. These places are called Hot spots
- (iv) When underground water comes in contact these hot spots, it changes into steam, which can be used to generate electricity.

Advantages of Geo thermal energy:

- (i) Renewable (ii) Inexpensive

Disadvantages of Geo thermal energy:

- (i) Only few sites available for harnessing energy.
- (ii) Expensive

(5) Nuclear Energy:

- (i) Energy released when some changes take place in the nucleus of the atom of a substance, is called Nuclear energy.
- (ii) It is used for heat generation, fuel for marine vessels.

Advantages of Nuclear Energy:

- (i) Alternative source of energy due to depletion of fossil fuels.
- (ii) From a small amount of fuel, a large amount of energy is released.

Disadvantages of Nuclear Energy:

- (i) Risk of nuclear waste leakage
- (ii) High cost of setting up of nuclear plant
- (iii) Pollution of environment.

(6) Energy from the sea-

(A) Tidal Energy: Locations in India - Gulf of Kutch, Gujrat & West Bengal

- (i) Depends upon harnessing the rise and fall of sea level due to tidal action.

- (ii) Dams are constructed across a narrow part of sea and turbine converts tidal energy into electrical energy. Disadvantages: Uniform tidal action is not seen

(B) Wave Energy:

- (i) Kinetic energy of the waves of sea are used to rotate turbines.
(ii) These turbines generate electrical energy

Important diagrams

1. Hydro power plant
2. Bio Gas Plant
3. A Wind mill
4. A solar cooker

One Mark Questions (One word or one sentence)

1. What is the alternative name for renewable sources of energy?

A. Non-conventional sources.

2. In what forms energy is utilized in our homes?

A. Fuels and electricity.

3. Is the heat of fire a source of energy?

A. Yes. It can be converted into mechanical or electrical energy.

4. Mention any two renewable sources of energy?

A. (a) Solar energy; (b) Wind energy

5. Mention any two uses of wind energy?

A. (a) To construct windmills; (b) To sail boats

6. What kind of energy is used by us while climbing stairs?

A. Muscular energy.

7. Name the main constituent of natural gas?

A. Methane.

8. Name any two constituents of coal gas?

A. Hydrogen (50%), carbon dioxide and methane.

Two Marks Questions (30 words)

1. What is meant by a source of energy?

A. We need energy to perform various functions of life. The materials that provide the requisite amount of energy are the source of energy.

For example:

- (i) We need heat energy to cook food. The various sources are: Fuels, wood, coal, kerosene, cooking gas etc.
- (ii) We need energy for our transport. The various sources are: Petrol, diesel.
- (iii) We need energy to light bulbs, tubes, to run radio, television and other power appliances. The source is electricity.
- (iv) Production in factories and agriculture also need energy. The source is diesel and electricity.

2. Classify the following as renewable and non-renewable sources of energy. Coal, flowing water, geothermal energy, nuclear energy, biogas, natural gas, petroleum, ocean waves, wood, flowing wind, cooking gas, biomass, hydroelectric power?

A. **Renewable sources of Energy:** Flowing water, geothermal energy, nuclear energy, biogas, ocean waves, wood, flowing wind, biomass, hydroelectric power.

Non-Renewable Sources: Coal, natural gas, cooking gas, petroleum.

3. What is meant by the transformation of energy? Explain giving an example?

A. The change of one form of energy into another form (or forms) of energy is called Transformation of Energy. The different forms of energy are: potential energy, kinetic energy, chemical energy, heat energy, solar energy, electrical energy and light energy. When a body from a height falls to the ground, its potential energy is converted into kinetic energy and then into heat energy.

4. Write two advantages of classifying energy sources as renewable and non-renewable?

A. Advantages of classifying energy sources as renewable or non-renewable are:

- (i) Which energy source should be used judiciously, that it could be used for max. Length of time,
E.g., non-renewable sources.
- (ii) To develop new methods to use a particular source economically,
E.g., renewable sources.

5. Why is the use of wood as a fuel not advised although forests can be replenished?

- A. It takes more than 15 years for a tree to mature. Cutting of wood also causes environment imbalances. Further burning of wood causes a lot of pollution. For these reasons it is not advised to use wood as a fuel.

6. State briefly the hazards of using conventional sources of energy?

- A. Some of the conventional sources of energy have poor efficiency and produce a lot of smoke due to incomplete combustion. For example,

Wood: As is well-known, wood is burnt in traditional cities. It has poor efficiency because only about 8% of the wood is utilised as fuel. Besides incomplete burning (combustion), it produces gases like carbon monoxide which are dangerous for health.

Agricultural wastes: Animal dung mixed with mud and made in the form of cakes and dried is burnt in many parts of the country for use for domestic purposes. As dung cakes are burnt inefficiently in the conventional manner, it produces a lot of smoke. Further as animal dung contains useful nutrients for soil, the burning of animal dung causes considerable wastage of useful elements, besides producing air pollution.

Agricultural Wastes: Agricultural wastes like sugarcane (from which juice has been extracted) are burnt for use in industries. This and other animal and plant wastes could more profitably be used in biogas plants.

7. Give the raw materials used for the preparation of biogas?

- A. The following materials may be used to produce biogas:
 - (i) Plant wastes like husk, grass, dry leaves, weeds, vegetable strains.

- (ii) Animal wastes like cow-dung, dungs of horse, elephant, goat and poultry wastes.
- (iii) Industrial and domestic wastes like mill dust, fruit and vegetable wastes.
- (iv) Human excreta and faecal matter.

8. What is biogas? How is it obtained from animal or plant wastes?

A. Biogas is a mixture of methane, hydrogen, carbon dioxide and hydrogen sulphide. Methane is the major constituent (65%). It is also called go-bar gas. Animal wastes and plant wastes contain a lot of carbon compounds like carbohydrates, proteins and fats. The anaerobic bacteria in the presence of water but in the absence of air, degrades these compounds to methane gas which is the main constituent. Other gases like CO_2 , H_2S , H_2 are also formed.

9. How is geothermal energy utilized?

A. Water is trapped into the earth at a number of places. At places where trapped water comes in contact with hot spots it gets converted into steam. Since this steam remains trapped between rocks, it gets compressed to a very high pressure. On drilling and introducing pipes up to the compressed steam, the trapped steam can be driven out at high speed. This can be utilized to turn the turbines and generate electricity. At some places steam and hot water find their way through large cracks between rocks and serve as natural geysers.

Three Marks Questions (50 words)

1. What are characteristics of a good fuel?

A. Characteristics of a good fuel:

1. It should burn easily.
2. It should product no residue or minimum residue on burning.
3. It should have low ignition temperature, but above room temperature.
4. It should be easy to store and transport.
5. It should burn at slow and controlled rate.
6. Combustion should be complete.
7. It should have high calorific value.

2. Describe briefly how is burning of common fuels harmful to health?

A. The burning of common fuels like coal, petrol produces harmful chemicals such as:

- (i) Coal on burning produces carbon dioxide, hydrogen and sulphur. Carbon dioxide as such is harmless but its increased proportion in air could cause undesirable changes in the environment. If the oxygen supply is insufficient, poisonous gas, carbon monoxide may also be produced. Sulphur in air produces sulphur dioxide which is an extremely suffocating and corrosive gas.
- (ii) When petrol burns in automobiles, harmful substances like unburnt hydrocarbons, carbon monoxide, oxides of nitrogen, some alcohols, acids and some lead compound are released.

3. What are wind energy farms?

A. The rotatory motion of the windmill can be utilized to rotate the armature of an electric generator in order to produce electricity. However, the electricity produced by a single windmill is quite small and thus cannot be used for commercial purposes. Therefore, a number of windmills are erected over a large area, The energy output of each windmill is coupled. This is called wind energy farms. The most essential condition for creating wind energy farms is to locate

an area where wind blows for greater part of the year at a speed of about 15 km/h.

4. State the advantages and disadvantages of using fossil fuels as source of energy?

A. **Advantages of using fossil fuels:** Petroleum and natural gas.

- (i) These leave no residue on burning.
- (ii) They have reasonably low ignition temperature and thus burn easily.
- (iii) The combustion is almost complete and thus no smoke is left on burning.
- (iv) Calorific value is higher than other usable fuels.

Disadvantages of using fossil fuels:

- (i) The end product is carbon dioxide which causes green house effect.
- (ii) When petrol is burnt, harmful substances like unburned hydrocarbons, carbon monoxide, oxides of nitrogen, sulphur are produced. These cause acid rain and thus soil and water pollution give innumerable problems to health.

5. What is nuclear energy? What is nuclear fission? How is nuclear energy used for peaceful purposes?

A. When the nucleus of an unstable atom breaks up or a radioactive substance emits radiations (α, β, γ rays), the energy so released together with radiations is called nuclear energy. This process is called nuclear fission. This nuclear energy when used in a controlled manner finds use in the following fields:

- (i) In curing of diseases, e.g., tumor and cancer.
- (ii) Radio isotopes are now-a-days used in research in various fields like industry, agriculture, science etc.
- (iii) Preservation of food, e.g., potatoes can be preserved for long periods if irradiated with γ - rays.
- (iv) In determining the age of archaeological remains of wood by a process known as carbon dating.
- (v) As a fuel—small amount of fuel produces a large amount of energy.

Five Marks Questions (70 words)

1. What causes the wind to blow? Explain the principle of working of a windmill. State two advantages of using wind energy?

A. Unequal heating of the landmass and water bodies by solar radiation generates air movement and causes winds to blow. The wind energy is the kinetic energy associated with the movement of large masses of air. It can be used to power windmills, sail boats and gliders.

Three factors responsible for creation of wind are:

- (i) Difference in temperature in the polar (cool) and equatorial regions.
- (ii) Rotation of the earth.
- (iii) Local conditions.

Principle of working windmill: The blades of a windmill are designed in such a way that when a wind blows over them, a pressure difference is created over the different regions. This pressure difference rotates the blades. To produce electricity, the rotatory motion of blades is utilized to rotate the armature of an electric generator. In a water lifting machine, the rotatory motion of the blades is made to do mechanical work.

Advantages of using Wind Energy:

- (i) It does not cause pollution in the environment.
- (ii) The cost of using fuel (i.e., air) is nil.

2. What is windmill? Draw a diagram to show how a windmill can be used to draw water from the ground?

A. Windmill is a simple device which works with the energy of the flowing wind. Huge blades are mounted on a suitable support in a wheel type arrangement so that these are rotated with the moving wind.

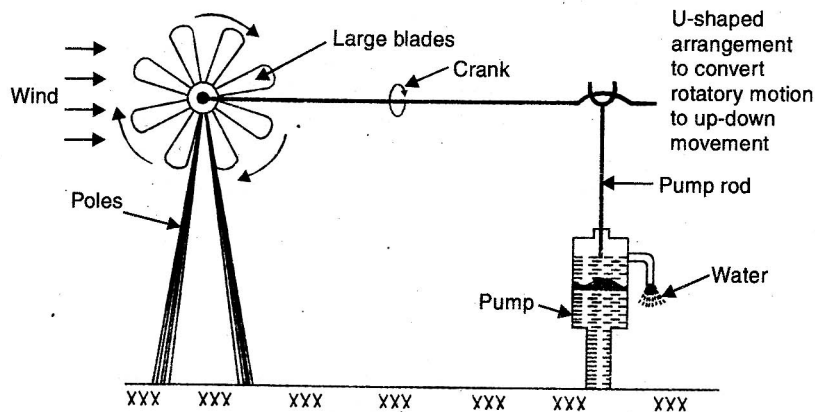


Fig. 14.2. Windmill used to lift water from flooded mines

The number of blades, their shape and the height of the windmill from the ground are decided on the basis of wind velocity and other environmental factors. The blades of a windmill are designed to create a pressure between its different regions when wind strikes them. This difference in pressure makes the blades to rotate.

These blades are connected to a long rod having a U shaped bend at the other end. The U shaped bend of the crank is connected to the rod of water pump. During the moving wind, as the wheels are rotated, the crank rod moves up and down and simultaneously the rod of water pump also moves up and down. The up and down motion of the pump rod would lift the water from ground.

3. What is a solar cooker? Draw a diagram of the domestic solar cooker and explain its working? (Or)

Describe the construction of a solar cooker. How does it cause a rise in temperature to cook food? (Or)

With the help of a diagram explain the construction and working of a box type solar cooker?

- A. Solar cooker is a device for the preparation of food by concentrating solar radiation on the food to be cooked. A box type solar cooker is shown in Fig. It consists of a box made of non-conducting materials like plastics, fiber glass or wood. The walls of the box are made thick so as to minimise loss of heat due to radiation. It is painted all black from inside.

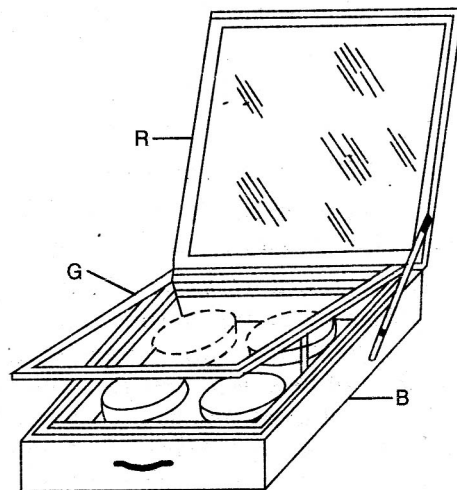


Fig. 14.4. *Solar cooker*

The box is covered with a thick glass sheet, G. A plane mirror reflector, R is attached in the inside cover of the box. The food to be cooked is kept in a container which is painted black from outside. The container is kept in the box and it is then covered with glass sheet. In order to cook the food, the assembly is kept in the sunlight and the reflector R is adjusted in such a way that a strong beam of light falls on the cooker top after reflecting from the mirror.

The sun rays after passing through the glass sheet are absorbed by the black surface of the box. Once the heat rays enter the box, glass sheet does not allow these to escape. In this way more and more heat gets trapped in the box and a temperature of 100°C – 140°C can be reached in two to three hours which is sufficient to cook the food like rice, dal and some vegetables kept in the black containers. Thus, these cookers can be used to cook food items that require slow heating and not for frying etc.

4. In brief discuss how a nuclear power plant uses a nuclear reactor to generate electricity?

A. Fig. shows the schematic diagram of a nuclear power plant. It consists of a nuclear reactor, a coolant pipe, a steam turbine and a dynamo.

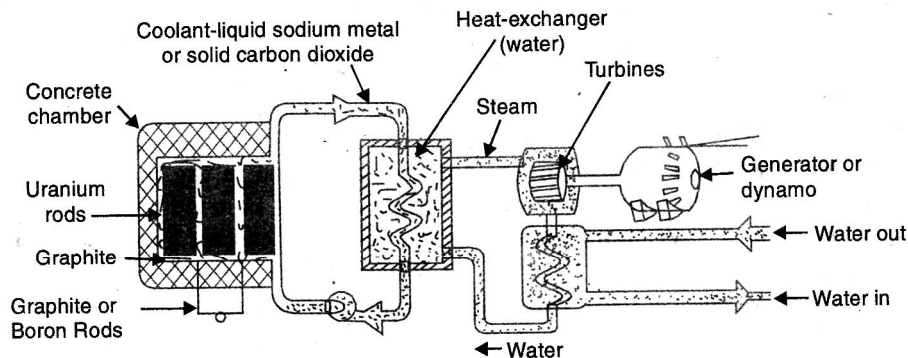


Fig. 14.5. *Diagram of a nuclear reactor. Heat generated by the fission process in the fuel is carried off by hot water or liquid sodium and is used to boil water to steam in the heat exchanger. The steam drives a turbine to generate electricity and then is cooled in the condenser.*

Nuclear Reactor: It is a kind of furnace covered with lead sheets and concrete walls. It is fitted with nuclear fuel container, moderator and controlling rods so that controlled fission of U-235 in it takes place and atomic energy is produced. The conversion of atomic energy into electricity involves the following steps:

(a) Enrichment of Nuclear Fuel: The radioactive material used in nuclear reactors for producing atomic energy by fission process is called a nuclear fuel. The nuclear fuel commonly used is an isotope of uranium, i.e., U-235. Ordinarily natural uranium contains a high percentage of stable U-238 which does not disintegrate easily and a very low percentage of U-235 or U-236 which can fission easily. Natural uranium as such cannot sustain a nuclear chain reaction. Therefore naturally occurring uranium is first processed (by physical processes of separation which depend on relative mass, e.g., ultra centrifugal techniques) to increase the percentage of fissionable uranium-235 in it. A sample containing 2-5% U-235 or U-236 can be used.

(b) Fission of U-235 (or U-236) (Role of Moderators): Fission of U-235 takes place satisfactorily when the bombarding neutron is slow. Energy is released when slow moving neutron bombards a U-235 nucleus (fission). This gives energy and more fast moving neutrons. Now these fast moving neutrons do not cause further fission. So that the fission process becomes continuous, speed of the ejected neutrons has to be decreased. A substance which slows down the speed of neutrons in the nuclear reactor to a level to cause effective fission of U-235 is called a moderator. Commonly used moderators are e or Graphite or heavy water is placed around the uranium rods. Neutrons ejected first strike

with the moderator, lose their kinetic energy and get slowed down. These slow neutrons bombard the uranium-235 nuclei and the process of liberation of energy and more of neutrons continues.

(c) Neutron absorbent or controlling rods (Attainment of criticality): As seen above an ordinary fission reaction produces a large number of neutrons which promotes chain reaction thus releasing tremendous amount of energy which becomes uncontrollable and leads to explosion. In order that the energy released may be tapped and utilized properly, fission of U-235 should take place in a controlled manner. This requires removal of excess neutrons which are being produced.

The excess neutrons are removed by using cadmium or boron rods because these elements have the ability to absorb neutrons and thus make them ineffective. Care should be taken that all the neutrons produced are not absorbed. The length of the cadmium (or boron) rods is so actuated in the reactor that the fission reaction is neither slow nor fast. (If the cadmium rod is inserted deeply, all the neutrons produced are absorbed and if they are withdrawn from the fuel, then all the neutrons will be available for fission and cause explosion or chain reaction).

(d) Coolant: Some pipes containing coolant are embedded in the reactor to take out the heat energy produced in it. Generally liquid sodium metal is used as the coolant which removes heat energy in a very short time. In some reactors, carbon dioxide or water is also used.

(e) Production of Electricity: The coolant pipes are passed through a tank half filled with water. The heat from the coolant is transferred to water and the hot pressurised steam is passed through the turbines. When the turbines rotate, the dynamo fixed on its shaft starts working and electricity is generated.

//o0o\\