

CHAPTER – 14

SOURCES OF ENERGY

ENERGY: - Whenever a body is capable of doing work, the body is said to possess energy. Thus energy is defined as the ability of a body to do work and the amount of energy possessed by a body is equal to the amount of work it can do when its energy is released.

Energy comes in different forms and one form can be converted to another. For example, if we drop a plate from a height, the potential energy of the plate is converted mostly to sound energy when it hits the ground.

Units of energy: - On S.I. system, energy is measured in the units of joules or in calories, and on C.G.S. system in ergs. However, the commercial unit of energy is kilowatt-hour. The energy is said to be one kilowatt-hour, when a body consumes one kilowatt of energy in one hour.

Sources of energy : a source of energy is that which is capable of providing enough useful energy at a steady rate over a long period of time.

A good source of energy should be :

- i) Safe and convenient to use, e.g., nuclear energy can be used only by highly trained engineers with the help of nuclear power plants. It cannot be used for our household purposes.
- ii) Easy to transport, e.g., coal, petrol, diesel, LPG etc. Have to be transported from the places of their production to the consumers.
- iii) Easy to store, e.g., huge storage tanks are required to store petrol, diesel, LPG etc.

Characteristics of an ideal or a good fuel:

- It should have a high calorific or a heat value, so that it can produce maximum energy by low fuel consumption.
- It should have a proper ignition temperature, so that it can burn easily.
- It should not produce harmful gases during combustion.
- It should be cheap in cost and easily available in plenty for everyone.
- It should be easily and convenient to handle, store and transport from one place to another.
- It should not be valuable to any other purpose than as a fuel.
- It should burn smoothly and should not leave much residue after its combustion.

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1. What is a good source of energy?

Ans. A good source of energy fulfils the following criteria:

- It produces a lot of heat per unit mass.
- It does a huge amount of work per unit mass.
- It is easily accessible.
- It is easy to store and transport.
- It is economical.
- It produces less amount of smoke.

2. What is a good fuel?

Ans. A good fuel produces a huge amount of heat on burning, does not produce a lot of smoke, and is easily available.

3. If you could use any source of energy for heating your food, which one would you use and why?

Ans. Natural gas can be used for heating and cooking food because it is a clean source of energy. It does not produce huge amount of smoke on burning. Although it is highly inflammable, it is easy to use, transport, and it produces a huge amount of heat on burning.

CLASSIFICATION OF SOURCES ENERGY :

The sources of energy can be classified as follows :

- (i) Renewable
- (ii) Non-Renewable.

1. Renewable sources of energy :-

Renewable sources of energy are those which are inexhaustible, i.e., which can be replaced as we use them and can be used to produce energy again and again. These are available in an unlimited amount in nature and develop within a relatively short period of time.

Examples of Renewable Sources of Energy.

- (i) Solar energy, (ii) Wind Energy, (iii) water energy (hydro-energy), (iv) geothermal energy,
- (v) ocean energy, (vi) biomass energy (firewood, animal dung and biodegradable waste from cities and crop residues constitute biomass).

Advantages of Renewable Sources of Energy :

- (i) These sources will last as long as the Earth receives light from the sun.
- (ii) These sources are freely available in nature.
- (iii) These sources do not cause any pollution.

2. Non-Renewable Sources of Energy :

Non-renewable sources of energy are those which are exhaustible and cannot be replaced once they have been used. These sources have been accumulated in nature over a very long period of million of years.

Examples of Non-renewable sources of Energy :

- (i) Coal (ii) Oil and (iii) Natural gas.
- All these fuels are called fossil fuels.

Disadvantages of Non-renewable sources of Energy :

- (i) Due to their extensive use, these sources are fast depleting.
- (ii) It is difficult to discover and exploit new deposits of these sources.
- (iii) These sources are a major cause of environmental pollution.

CONVENTIONAL AND NON-CONVENTIONAL SOURCES OF ENERGY :

Sources of energy are also classified as :

- (i) Conventional sources of energy
- (ii) Nonconventional sources of energy.

CONVENTIONAL SOURCES OF ENERGY

FOSSIL FUELS

Fossil fuels are the remains of prehistoric plants and animals which got buried deep inside the earth millions of years ago due to some natural processes.

The energy of fossil fuels is in fact, that solar energy which was trapped by natural processes a very long time ago. Coal, petroleum and natural gas are fossil fuels.

Formation of Fossil Fuels: During its formation, an entire organism or its parts often get buried in sand or mud. These, then decay and disintegrate leaving no signs of their existence. In fact, the harder parts of organisms after their death, settle down and are covered by sediments and subjected to extreme pressure and temperature of the earth converts them into fossil fuels, the process being referred to as fossilization.

Disadvantages of Fossil Fuels:

1. The fossil fuels are non-renewable sources of energy and once used cannot be renewed.
2. Burning of fossil fuels causes air pollution.
3. The fossil fuels reserves in the earth are limited and may get exhausted soon.

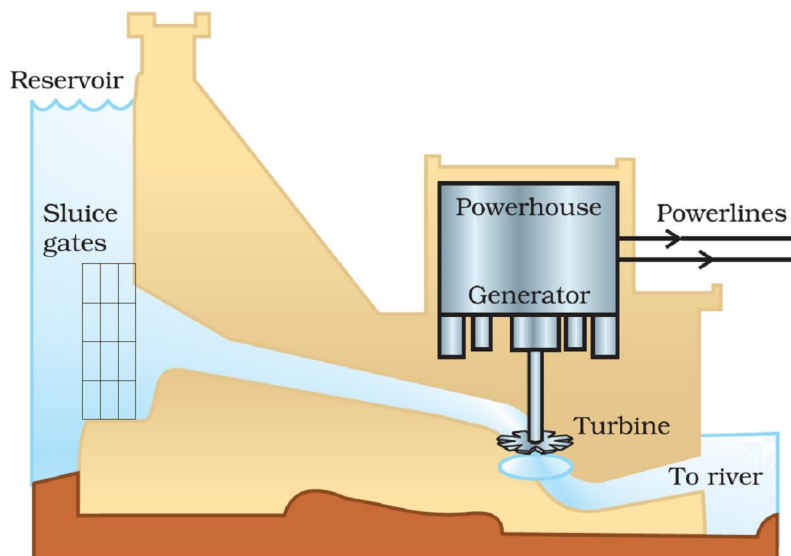
THERMAL POWER PLANT

The term thermal power plant is used since fuel is burnt to produce heat energy which is converted into electrical energy.

Large amount of fossil fuels are burnt every day in power stations to heat up water to produce steam which further runs the turbine to generate electricity. The transmission of electricity is more efficient than transporting coal or petroleum over the same distance. Therefore, many thermal power plants are set up near coal or oil fields.

HYDRO POWER PLANTS

Hydro power plants convert the potential energy of falling water into electricity. Since there are very few water-falls which could be used as a source of potential energy, hydro power plants are associated with dams.



In order to produce hydel electricity, high-rise dams are constructed on the river to obstruct the flow of water and thereby collect water in larger reservoirs. The water level rises and in this process the kinetic energy of flowing water gets transformed into potential energy. The water from the high level in the dam is carried through

pipes, to the turbine, at the bottom of the dam (see the above Fig.). Since the water in the reservoir would be refilled each time it rains (hydro power is a renewable source of energy) we would not have to worry about hydroelectricity sources getting used up the way fossil fuels would get finished one day.

Advantages of generating hydro electricity :- The main advantages of using water energy for the generation of hydro electricity are listed as under :

1. It is readily and abundantly available everywhere free of cost.
2. It is eco-friendly and does not produce any kind of environmental pollution.
3. It is a renewable source as water itself is a renewable and inexhaustible resource.
4. It is a cheap source of energy, as it does not involve any costly investment.

BIO-MASS

Biomass is defined as living matter or its residue and is a renewable sources of energy.

The biomass includes (i) all the new plant growth (ii) agricultural and forest residues (like biogases, bark, saw dust, wood shavings, roots, animal droppings etc.) (iii) Carbonaceous wastes (like sewage, garbage, night-soil, etc.) (iv) Biodegradable organic affluent from industries.

Biogas:- Biogas is a mixture of gases produced by anaerobic degradation of biomass in the presence of water but in the absence of oxygen. It is a renewable source of energy on account of its production from vastly and continuously available organic wastes.

Advantages of Biogas:-

- i) A biogas plant, being quite simple, can easily be built in rural areas. A small plant using dung from 3 to 4 heads of cattle is capable of supplying biogas for 6 hours daily for cooking purposes.
- ii) Biogas is a clean fuel that burns without smoke and leaves no ash.
- iii) The main constituent of biogas, i.e., ethane has a higher calorific value (55kj/g) that of petrol (50kj/g).
- iv) The spent slurry, being rich in nitrogen and phosphorus, is good manure.
- v) By using biogas, firewood is saved and deforestation is reduced.

Composition of Biogas:- Biogas is mainly composed methane (up to 75%), CO₂ (25%) and traces of other gases such as nitrogen and hydrogen. Whereas methane is a high value calorific fuel, carbon dioxide is an inert gas.

Biogas is prepared in biogas plants which are of two types: (i) Fixed Dome Type (ii) Floating Gas Holder Type.

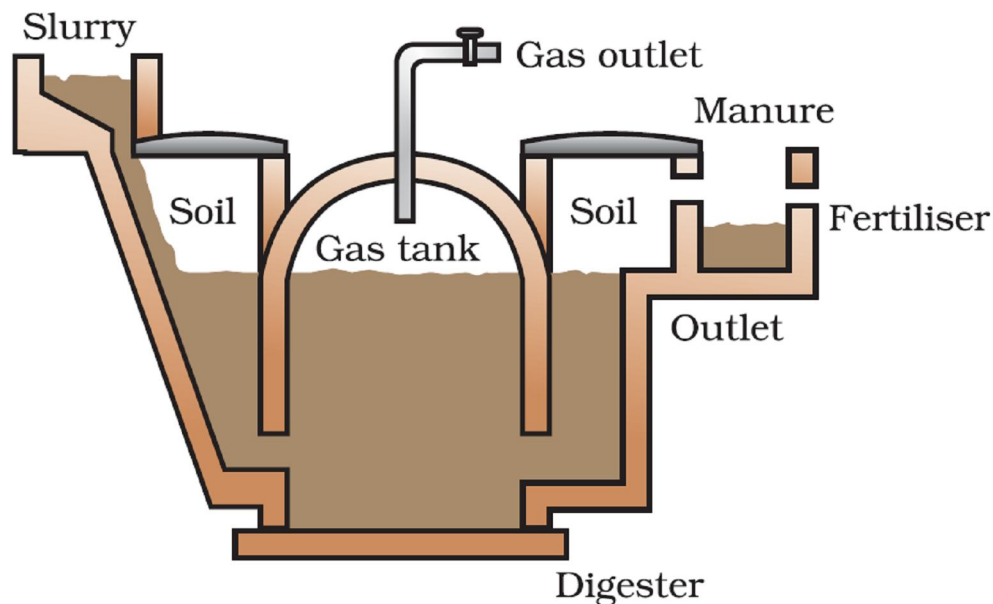
Fixed Dome Type Biogas Plant:-

The main parts of fixed of dome type of biogas plants are:

1. Digester. It is well shaped underground tank made of bricks. Its roof is some-shaped which acts as a storage tank for biogas.
2. Mixing tank. It is constructed on the ground level where cattle dung and water are mixed.
3. Inlet tank. It is constructed underground below the mixing tank.
4. Overflow tank. It is constructed slightly below the level of mixing tank.
5. Outlet tank. It is constructed below the overflow tank.

Working of Biogas Plant:-

Cattle dung and water are mixed in equal proportion in the mixing tank to form slurry. This slurry is fed into the digester tank through inlet tank when the digester tank is filled about 2/3rd of its capacity, the dome is left free for collection of biogas. The slurry undergoes anaerobic fermentation and biogas is produced after 50 to 60 days. As biogas is collected in the dome it exerts pressure due to which spent slurry goes to the overflow tank through outlet tank and fresh slurry is fed into the digester and continuous supply of biogas is obtained spent slurry is used as manure.



WIND ENERGY

Wind Energy: -When large masses of air move from one place to another it is referred to as wind. During this process kinetic energy gets associated with it which is referred to as wind energy.

Principle of utilisation of wind energy: -

Wind energy is efficiently converted into electrical energy with the aid of a windmill. A windmill is a large fan having big blades, which rotate by the force exerted by moving wind on them. These blades remain continuously rotating as long as wind is blowing and can be used to drive a large number of machines like water pumps, flour mills etc. But these days a windmill is used to generate electric current which is used for various purposes and therefore wind power stations are established all over the world which convert wind energy directly into electrical energy.

Uses of wind energy: -

The important uses of wind energy are;

1. It is used to drive windmills, water lifting pumps and flour mills etc.
2. It is used to propel sail boats.
3. It is used to fly engine less aeroplanes or gliders in the air.
4. It is used to generate electricity used for various purposes like lighting, heating etc.



Advantages of generating wind energy: -

The chief advantages of using wind energy are;

1. It is readily and abundantly available at every place of the earth free of cost.
2. It is eco-friendly and does not produce any kind of environmental pollution.
3. It is a renewable source as air itself is a renewable and inexhaustible resource.
4. It is a cheap source of energy, as it does not involve any costly investment.

INTEXT QUESTIONS PAGE NO. 248

1. What are the disadvantages of fossil fuels?

Ans. The disadvantages of fossil fuels are as follows:

- (a) Burning of coal and petroleum produces a lot of pollutants causing air pollution.
- (b) Fossil fuels release oxides of carbon, nitrogen, sulphur, etc. that cause acid rain, which affects the soil fertility and potable water.
- (c) Burning of fossil fuels produce gases such as carbon dioxide that causes global warming.

2. Why are we looking at alternate sources of energy?

Ans. Fossil fuels, which have been traditionally used by human beings as an energy sources, are non-renewable sources of energy. These sources of energy are limited and cannot replenish on their own. They are being consumed at a large rate. If this rate of consumption continues, then the fossil fuels would be exhausted from the Earth. Therefore, we have to conserve the energy sources. Hence, we should look for alternate sources of energy.

How has the traditional use of wind and water energy been modified for our convenience?

Traditionally, waterfalls were used as a source of potential energy which was converted to electricity with the help of turbines. Since waterfalls are few in number, water dams have been constructed in large numbers. Nowadays, hydro-dams are used in order to harness potential energy of stored water. In water dams, water falls from a height on the turbine, which produces electricity.

Earlier, the windmills were used to harness wind energy to do mechanical work such as lifting/drawing water from a well. Today, windmills are used to generate electricity. In windmills, the kinetic energy of wind is harnessed and converted into electricity. The rotatory motion of the blades turns the turbine of the electric generator to generate electricity.

ALTERNATIVE OR NON-CONVENTIONAL SOURCES OF ENERGY

Non-conventional sources of energy : Non-conventional source of energy are those which are not used as extensively as the conventional ones and meet our energy requirement only on a limited scale. Solar energy, ocean energy (tidal energy, wave energy, ocean thermal energy, OTE), Geothermal energy and nuclear energy belong to this category. These sources of energy which have been tapped with the aid of advances in technology to meet our growing energy needs are also called alternative sources of energy.

SOLAR ENERGY

The energy produced by the sun in the form of heat and light energy is called as solar energy.

Principles of utilisation of Solar Energy: - Solar energy is utilised by the involvement of two main principles:

(i). In the appliances requiring a moderate temperature, the incident sun rays are reflected by a plain mirror on a black container which absorbs the solar energy and gets heated .

(ii). In the appliances requiring a high temperature, the incident sun rays are reflected and concentrated by using a large concave reflector which focuses all the sun rays at a single point called focus and any object kept at the focus gets strongly heated.

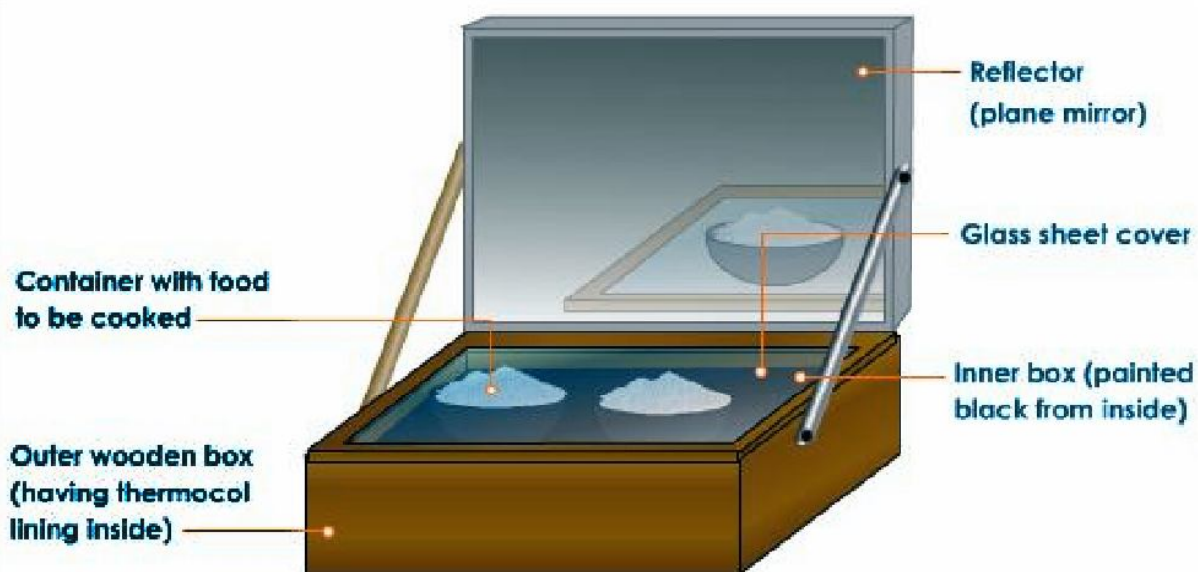
Harnessing or utilisation of Solar energy:- The sun is the ultimate source of energy having a remarkable capacity to produce energy in the form of heat and light. The energy produced by the sun in one day is about 50,000 times more than the energy consumed in the whole world in one year. But solar energy has certain limitations, which does not facilitate its large-scale utilisation. However, solar energy can be put to use in two differ ways Viz.

1) Direct utilization: - Directly the solar energy can be used either by collecting it as heat energy or by converting it into electricity.

2) Indirect utilization: - Indirectly the solar energy can be utilized by converting it into chemical energy like biomass or by utilising the energy obtained from wind, sea waves, tides etc.

Solar Heating Devices: - A device that gets heated by absorbing solar energy radiated by the sun in the form of heat and light energy is called a solar heating device. For eg. Solar cooker, solar water heater, solar furnace and solar cells are solar heating devices.

Solar cooker: - A solar cooker is a device which utilises solar energy for cooking food material. It consists of an insulated wooden box (B) painted with black from inner side. The lid of the box is provided with a plane mirror reflector (R) and a glass sheet (G). The food to be cooked is placed in a metal container (C) painted with black from outer side and kept in the box .The container is covered with the glass sheet. The box is then kept in direct sunlight and its reflector is adjusted in such away that a strong beam of sun light falls over it.



Working: - When the solar cooker is kept in direct sunlight, the reflector (R) reflects both visible and infrared rays of the sunlight on to the top of the box in the form of a strong beam of light. The black surface of the box and the vessel absorbs it. When the inner black surface becomes quite hot, it also starts radiating heat energy in the form of infrared rays, but the upper glass sheet (G) does not allow these rays to pass through it and go outside the box. As a result, these infrared rays get absorbed in the box, which increases its internal temperature up to about 100°C. This high temperature cooks the food material kept in the metallic container inside the box.

Limitations of solar Cooker:-

1. It can not be used during night.
2. On a cloudy day, it can not be used.
3. The direction of the reflector has to be adjusted according to the position of the sun.
4. It can not be used for making 'chappatis'.
5. It can not be used for frying.

Solar cell: - A solar cell is a device which converts solar energy (light energy) directly into electricity. It is made of semi-conducting material like silicon, germanium, selenium or gallium. A modern solar cell is made from wafers of semi conducting materials containing impurities in such away that a potential difference gets generated when light falls on them. A 4 cm² solar cells produces a potential difference of about 0.4--0.5volts and generate about 60 milli-amperes of current. To generate a large amount of current a number of solar cells are arranged together in a definite pattern in a solar panel. The energy (electric current) generated in a solar panel is stored in a battery connected to it and can be used for various purposes.

Uses of a solar cell: - The solar cells are used effectively in various fields, but some of its important uses are:

Solar cells are used for production of electricity for lighting, houses, streets etc. Solar cells are used for production of electricity to run electronic appliances like televisions, radios, watches, calculators, toys, toy games etc. Solar cells are used to develop electricity for offshore oil drilling platforms etc. Solar cells are used to generate electricity in artificial satellites, rockets, and space vehicles etc.

ENERGY FROM THE SEA

Energy from Oceans : - The oceans acquire almost 71% of the surface of the earth and the enormous amount of water present in them not only act as a big collector of solar heat energy, but also store large amount of it due to its high specific heat. Thus ocean water can be used as a renewable resource of energy. The main forms of ocean energy are described as under;

i) Ocean Thermal energy : - The energy available due to the temperature difference between the deeper levels and surface of an ocean is called as ocean thermal energy.

ii) Ocean Tidal energy : - The rise of ocean water due to attraction of the moon is referred to as high tide and its fall as low tide. The enormous movement of water due to high and low tide provide a large amount of energy known as ocean tidal energy. This tidal energy can be utilised by constructing a tidal barrage or dam.

iii) Sea wave energy: - The energy obtained from the high speed sea waves is referred to as sea wave energy. Infact these high speed sea waves have a lot of kinetic energy associated with them, which can used to drive dynamos which convert kinetic energy into electrical energy.

iv) Energy from Nuclear deuterium of oceans: - The ocean water contains unlimited amount of heavy hydrogen isotope called deuterium which is isotope hydrogen having one proton and one neutron in its nucleus. Scientists are working hard to produce energy by carrying by out controlled nuclear fission of deuterium isotope. The process is still in its experimental stage.

v) Energy from Salinity gradient in seas: - The difference in the concentration of salts in the water of the two or more seas is called as salinity gradient. This salinity gradient is now a day used to obtain energy with the involvement of suitable techniques.

vi) Energy from sea vegetation or biomass: - Sea vegetation or biomass is another direct source of energy because the enormous amount of sea weeds present in the sea water provides an endless supply of methane fuel.

Limitations of Energy from Oceans :-

The limitations of energy that can be obtained from the oceans are:

- i) Tidal Energy for which very few suitable sites are available for construction of dams and the power generation is intermittent and not very large.
- ii) Wave Energy where power output is variable and the presently available technologies are very expensive.
- iii) Ocean Thermal Energy where the conversion efficiency is low (3% - 4%) and a lot of capital investment is required.

GEOHERMAL ENERGY

Geothermal energy is the heat of the earth and is the naturally occurring thermal energy found within rock formations and the fluids held within those formations.

Geothermal energy is one of those few sources of energy that do not come directly or indirectly from the solar energy.

The underground hot water in contact with hot spots changes into steam. As the steam is trapped between the rocks, it gets compressed to high pressure. At some places, hot water and steam gush out from the Earth's surface after making their way through large cracks between the rocks and form natural geysers. Geothermal energy carried by natural geysers is utilized for generating electricity.

Merits if geothermal Energy:-

1. Geothermal energy is the most versatile and least polluting renewable source of energy.
2. It can be harnessed for 24 hours throughout the year.
3. Geothermal energy is relatively inexpensive.
4. As compared to solar energy and wind energy, the power generation level of geothermal energy is higher.
5. Geothermal energy can be used for power generation as well as direct heating. In USA, water is pumped from underground hot water deposits and is used to heat houses.

Limitations of Geothermal Energy:

1. Geothermal hot spots are scattered and usually some distance away fro the areas that need energy.

2. The overall power production has a lower efficiency (about 15%) as compared to that of fossil fuels (35% to 40%).
3. Though as a whole, geothermal energy is inexhaustible, a single by ore has a limited life span of about 10 years.
4. Noise pollution is caused by drilling operations at geothermal sites.

NUCLEAR ENERGY

A reaction in which the nucleus of an atom undergoes a change to form a new atom and releases an enormous amount of energy is called as nuclear energy. There are two distinct ways of obtaining nuclear energy. a) Nuclear fission b) Nuclear fusion.

Nuclear Fission reaction:

This type of nuclear reaction was first of all reported by Otto Hahn in 1938. He stated that when an unstable heavy nucleus is bombarded with slow speed thermal neutrons, it splits into two small stable nuclei liberates an enormous amount of heat and light energy.

Nuclear Fusion reaction:

This type of nuclear reaction was first of all reported by Hans Bethe in 1939. The word 'fusion' means 'to combine together'. So, nuclear fusion means combining together of two or more nuclei to form a single nucleus. Thus, a process in which two lighter nuclei fuse (combine) together to form a stable heavier nucleus with a simultaneous release of a very large amount of energy is called nuclear fusion. The energy produced in a fusion reaction is much higher than that produced in a nuclear fission reaction.

Advantages of Nuclear Energy:-

The advantages of nuclear energy are that:

1. It produces a large amount of useful energy from a very small amount of a nuclear fuel (like uranium-235).
2. Once the nuclear fuel (like uranium-235) is loaded into the reactor, the nuclear power plant can go on producing electricity for two to three years at a stretch. There is no need for putting in nuclear fuel again and again.
3. It does not produce gases like carbon dioxide which contributes to greenhouse effect or sulphur dioxide which causes acid rain.

Disadvantages of Nuclear Energy :-

1. The major hazard of nuclear power generation is the storage and disposal of spent or used fuels – the uranium still decaying into harmful subatomic particles (radiations).
2. Improper nuclear-waste storage and disposal result in environmental contamination.
3. **There is a risk of accidental leakage of nuclear radiation.**
4. The high cost of installation of a nuclear power plant, high risk of environmental contamination and limited availability of uranium makes large-scale use of nuclear energy prohibitive

INTEXT QUESTIONS PAGE NO. 253

1. What kind of mirror – concave, convex or plain – would be best suited for use in a solar cooker? Why?

Ans. A solar cooker uses heat of the sunlight to cook and heat food. A mirror is used in order to reflect and focus sunlight at a point. A concave mirror is used in a solar cooker for this purpose. The mirror focuses all the incident sunlight at a point. The temperature at that point increases, thereby cooking and heating the food placed at that point.

2. What are the limitations of the energy that can be obtained from the oceans?

Ans. The forms of energy that can be obtained from the ocean are tidal energy, wave energy, and ocean thermal energy. There are several limitations in order to harness these energies.

(i) Tidal energy depends on the relative positioning of the Earth, moon, and the Sun.

(ii) High dams are required to be built to convert tidal energy into electricity.

(iii) Very strong waves are required to obtain electricity from wave energy.

(iv) To harness ocean thermal energy efficiently, the difference in the temperature of surface water (hot) and the water at depth (cold) must be 20°C or more.

3. What is geothermal energy?

Ans. Geothermal power plants use heat of the Earth to generate electricity. This heat energy of the Earth is known as geothermal energy.

When there are geological changes, the molten rocks present in the core of the earth are pushed to the earth's crust. This forms regions of hot spot. Steam is generated when the underground water comes in contact with these hot spots forming hot springs. This trapped steam is used to generate electricity in the geothermal power plants.

4. What are the advantages of nuclear energy?

Ans. The advantages of nuclear energy are as follows:

(a) Large amount of energy is produced per unit mass.

(b) It does not produce smoke. It is a clean energy.

(c) Fission of one atom of uranium produces 10 million times the energy released by burning of one atom of carbon.

(d) Fusion of four hydrogen atoms produces huge amount of energy approximately equal to 27 MeV.

ENVIRONMENTAL CONSEQUENCES

1. The combustion for fossil fuels is producing acid rain and damaging plants (crops), soil and aquatic life.
2. The burning of fossil fuels is increasing the amount of greenhouse gas carbon dioxide in the atmosphere.
3. The cutting down of trees from the forest (deforestation) for obtaining fire-wood is causing soil erosion and destroying wild life.
4. The construction of hydro-power plants is disturbing ecological balance.
5. Nuclear power plants are increasing radioactivity in the environment.

INTEXT QUESTIONS PAGE NO. 253

1. Can any source of energy be pollution-free? Why or why not?

Ans. No source of energy can be pollution-free. It is considered that solar cells are pollution-free. However, even their making causes environmental damage indirectly.

Also, in the case of nuclear energy, there is no waste produced after the fusion reactions. However, it is not totally pollution-free. To start the fusion reactions, approximately 10^7 K temperature is required, which is provided by fission reactions. The wastes released from fission reactions are very hazardous. Hence, no source of energy is pollution-free.

2. Hydrogen has been used as a rocket fuel. Would you consider it a cleaner fuel than CNG? Why or why not?

Ans. Hydrogen gas is cleaner than CNG. CNG contains hydrocarbons. Therefore, it has carbon contents. Carbon is a form of pollutant present in CNG. On the other hand, hydrogen is waste-free. The fusion of hydrogen does not produce any waste. Hence, hydrogen is cleaner than CNG.

INTEXT QUESTIONS PAGE NO. 254

1. Name two energy sources that you would consider to be renewable. Give reasons for your choices.

Ans. Two renewable sources of energy are as follows:

(a) Sun: The energy derived from the Sun is known as solar energy. Solar energy is produced by the fusion of hydrogen into helium, fusion of helium into other heavy elements, and so on. A large amount of hydrogen and helium is present in the Sun. Therefore, solar energy can replenish on its own. The Sun has 5 billion years more to burn. Hence, solar energy is a renewable source of energy.

(b) Wind: Wind energy is derived from air blowing with high speed. Wind energy is harnessed by windmills in order to generate electricity. Air blows because of uneven heating of the Earth. Since the heating of the Earth will continue forever, wind energy will also be available forever.

2. Give the names of two energy sources that you would consider to be exhaustible. Give reasons for your choices.

Ans. Two exhaustible energy sources are as follows:

(a) Coal: It is produced from dead remains of plants and animals that remain buried under the earth's crust for millions of years. It takes millions of years to produce coal. Industrialization has increased the demand of coal. However, coal cannot replenish within a short period of time. Hence, it is a non-renewable or exhaustible source of energy.

(b) Wood: It is obtained from forests. Deforestation at a faster rate has caused a reduction in the number of forests on the Earth. It takes hundreds of years to grow a forest. If deforestation is continued at this rate, then there would be no wood left on the Earth. Hence, wood is an exhaustible source of energy.

EXERCISE QUESTIONS PAGE NO. 254

1. A solar water heater cannot be used to get hot water on

(a) a sunny day (b) a cloudy day (c) a hot day (d) a windy day

Ans. (b) A solar water heater uses solar energy to heat water. It requires bright and intense sunlight to function properly. On a cloudy day, the sunlight reflects back in the sky from the clouds and is unable to reach the ground. Therefore, solar energy is not available for the solar heater to work properly. Hence, solar water heater does not function on a cloudy day.

2. Which of the following is not an example of a bio-mass energy source?

- (a) wood (b) gobar gas (c) nuclear energy (d) coal

Ans. (c) Bio-mass is a source of energy that is obtained from plant materials and animal wastes. Nuclear energy is released during nuclear fission and fusion. In nuclear fission, uranium atom is bombarded with low-energy neutrons. Hence, uranium atom splits into two relatively lighter nuclei. This reaction produces huge amount of energy. In nuclear fusion reaction, lighter nuclei are fused together to form a relatively heavier nuclei. This reaction produces tremendous amount of energy. Hence, nuclear energy is not an example of bio-mass energy source.

Wood is a plant material, *gobar* gas is formed from animal dung, and coal is a fossil fuel obtained from the buried remains of plants and animals. Hence, these are bio-mass products.

3. Most of the sources of energy we use represent stored solar energy. Which of the following is not ultimately derived from the Sun's energy?

- (a) Geothermal energy
(b) Wind energy
(c) Nuclear energy
(d) Bio-mass

Ans. (c) Nuclear energy is released during nuclear fission and fusion. In nuclear fission, uranium atom is bombarded with low-energy neutrons. Hence, uranium atom splits into two relatively lighter nuclei. This reaction produces huge amount of energy. In nuclear fusion reaction, lighter nuclei are fused together to form a relatively heavier nuclei. The energy required to fuse the lighter nuclei is provided by fission reactions. This reaction produces tremendous amount of energy. These reactions can be carried out in the absence or presence of sunlight. There is no effect of sunlight on these reactions. Hence, nuclear energy is not ultimately derived from Sun's energy.

Geothermal energy, wind energy, and bio-mass are all ultimately derived from solar energy. Geothermal energy is stored deep inside the earth's crust in the form of heat energy. The heating is caused by the absorption of atmospheric and oceanic heat. It is the sunlight that heats the atmosphere and oceans.

Wind energy is harnessed from the blowing of winds. The uneven heating of the earth's surface by the Sun causes wind.

Bio-mass is derived from dead plants and animal wastes. Chemical changes occur in these dead plants and animal wastes in the presence of water and sunlight. Hence, bio-mass is indirectly related to sunlight.

4. Compare and contrast fossil fuels and the Sun as direct sources of energy.

Ans.

Fossil fuels are energy sources, such as coal and petroleum, obtained from underneath the Earth's crust. They are directly available to human beings for use. Hence, fossil fuels are the direct source of energy. These are limited in amount. These are non-renewable sources of energy because these cannot be replenished in nature. Fossil fuels take millions of years for their formation. If the present fossil fuel of the Earth gets exhausted, its formation will take several years. Fossil fuels are also very costly.

On the other hand, solar energy is a renewable and direct source of energy. The Sun has been shining for several years and will do so for the next five billion years. Solar energy is available free of cost to all in unlimited amount. It replenishes in the Sun itself.

5. Compare and contrast bio-mass and hydro electricity as sources of energy.

Ans.

Bio-mass and hydro-electricity both are renewable sources of energy. Bio-mass is derived from dead plants and animal wastes. Hence, it is naturally replenished. It is the result of natural processes. Wood, *gobar* gas, etc. are some of the examples of bio-mass.

Hydro-electricity, on the other hand, is obtained from the potential energy stored in water at a height. Energy from it can be produced again and again. It is harnessed from water and obtained from mechanical processes.

6. What are the limitations of extracting energy from –

(a) the wind? (b) waves? (c) tides?

Ans.

(a) Wind energy is harnessed by windmills. One of the limitations of extracting energy from wind is that a windmill requires wind of speed more than 15 km/h to generate electricity. Also, a large number of windmills are required, which covers a huge area.

(b) Very strong ocean waves are required in order to extract energy from waves.

(c) Very high tides are required in order to extract energy from tides. Also, occurrence of tides depends on the relative positions of the Sun, moon, and the Earth.

7. On what basis would you classify energy sources as

(a) renewable and non-renewable?

(b) exhaustible and inexhaustible?

Are the options given in (a) and (b) the same?

Ans.

(a) The source of energy that replenishes in nature is known as renewable source of energy. Sun, wind, moving water, bio-mass, etc. are some of the examples of renewable sources of energy.

The source of energy that does not replenish in nature is known as non-renewable source of energy. Coal, petroleum, natural gas, etc. are some of the examples of non-renewable sources of energy.

(b) Exhaustible sources are those sources of energy, which will deplete and exhaust after a few hundred years. Coal, petroleum, etc. are the exhaustible sources of energy.

Inexhaustible resources of energy are those sources, which will not exhaust in future. These are unlimited. Bio-mass is one of the inexhaustible sources of energy.

Yes. The options given in (a) and (b) are the same.

8. What are the qualities of an ideal source of energy?

Ans.

An ideal source of energy must be:

(i) Economical

(ii) Easily accessible

(iii) Smoke/pollution free

(iv) Easy to store and transport

(v) Able to produce huge amount of heat and energy on burning

9. What are the advantages and disadvantages of using a solar cooker? Are there places where solar cookers would have limited utility?

Ans.

Solar cooker uses Sun's energy to heat and cook food. It is inexhaustible and clean renewable source of energy. It is free for all and available in unlimited amount. Hence, operating a solar cooker is not expensive.

Disadvantage of a solar cooker is that it is very expensive. It does not work without sunlight. Hence, on cloudy day, it becomes useless.

The places where the days are too short or places with cloud covers round the year, have limited utility for solar cooker.

- 10.** What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

Ans.

Industrialization increases the demand for energy. Fossil fuels are easily accessible sources of energy that fulfil this demand. The increased use of fossil fuels has a harsh effect on the environment. Too much exploitation of fossil fuels increases the level of green house gas content in the atmosphere, resulting in global warming and a rise in the sea level.

It is not possible to completely reduce the consumption of fossil fuels. However, some measures can be taken such as using electrical appliances wisely and not wasting electricity. Unnecessary usage of water should be avoided. Public transport system with mass transit must be adopted on a large scale. These small steps may help in reducing the consumption of natural resources and conserving them.