PHYSICS

CHAPTER -7- ENERGY MANAGEMENT

Conservation of Energy

Energy can neither be created nor destroyed but it can be converted from one form to another.

Example: solar energy is converted into electrical energy/heat energy

Different sources of energy

I. FUELS

- **Fuels are substances release plenty of heat energy on burning**
- **Fuels can be classified into solid, liquid and gas**

Solid	Liquid	Gas
Coal	Gasoline/ petrol	Natural gas
Coke	Kerosene	LPG
Wood	Diesel	Coal gas
Cow dung cake	Fuel oil/ coal tar	Producer gas
Charcoal	Ethanol	Hydrogen

Combustion of Fuels

- **There are two types of combustion of fuels, complete combustion and partial combustion.**

Complete combustion	Partial combustion
Reaction of fuels with intensively oxygen	Reaction of fuels in the absence of deficiency of oxygen
Produce CO_2, heat, steam and light	Produce CO, soot and smoke
No ambient air pollution	Causes air pollution
e.g burning of stretched paper	e.g burning of crumbled paper

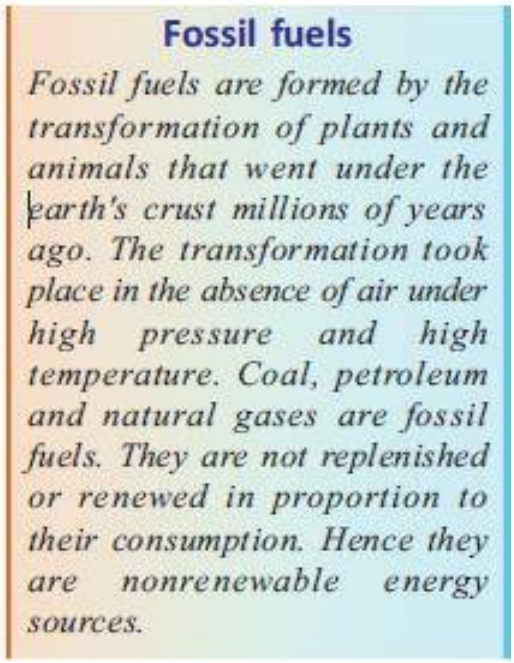
Note: Pollution test is conducted to know whether the components in the gases released from the vehicle exceeded the permissible limit.

Q) what are the draw backs of partial combustion?

Ans)

- Loss of fuel
- Atmospheric pollution
- Produce poisonous gas like carbon monoxide
- Form soot and smoke
- Wastage of time and money

FOSSIL FUELS



Coal	Petroleum	Natural gas
Coke	Petrol	LNG
Coal tar	Kerosene	CNG
Charcoal	Diesel	Producer gas
Lignite/ peat	Crude oil	Water gas / biogas

Coal

- **Most abundant fossil fuel on earth crust**
- **Main component is carbon**
- **Based on carbon content it is classified into four peat, lignite, anthracite and bituminous coal.**
- **When it is distilled in the absence of air ammonia, coal gas, coal tar and coke are obtained.**

CNG / LNG	LPG
CNG- compressed natural gas LNG- liquefied natural gas	LPG – liquefied petroleum gas
Mani component is methane	Main component is butane
Used in vehicles and thermal power plants	Used in domestic cooking fuel
Can be easily transport to other places and store.	Obtained by fractional distillation of petroleum
Have characteristic smell	Have no colour no odour.
Calorific value is less compared to LPG	Ethyl mercaptan is added to LPG to produce an odour

- Marking in LPG
  Letter A represent month January - March (expiry date)
  B – April -June, C -July- September, D – October – December
  Numbers 22, means up to 2022 is maturity period
  e.g if a cylinder is marked as A-24 means its maturity period is up to March 2024
- **BLEVE –** Boiling Liquid Expanding Vapour Explosion
  The explosion of gas cylinder by increasing the pressure inside the cylinder up to 200 times
- If there is any leakage in gas cylinder do the following
  - Disconnect electricity from outside the home
  - Switch off the regulator and shift the cylinder to an empty space
  - Open the doors and windows
  - Request help from fire force calling toll free number 108

II. **BIOMASS**

The body parts/ waste of plants and animals on the earth surface is called biomass. They have characteristic smell

III. **BIOGAS**

When bio waste is deposited in a biogas plant in the absence of oxygen, biogas is formed by the action of bacteria. Its main constituents are methane and carbon dioxide. The slurry discharged from the biogas plant is good manure. When biomass is converted into biogas, not only a fuel of greater calorific value is obtained but the atmospheric pollution is also minimised.

Q) what are the advantages of biogas over biomass?

Ans)

- **More calorific value**
- **No pollution**
- **Slurry can be used as manure**

Calorific value

The amount of heat liberated by the complete combustion of 1 Kg of fuel is its calorific value. Its unit is kilojoules/ kilogram (KJ/Kg)

Hydrogen	– 150000 kJ/kg
CNG	– 50000 kJ/kg
Dried cow dung	– 6000 – 8000 kJ/kg
LPG	– 55000 kJ/kg
Biogas	– 30000 – 40000 kJ/kg
Coal	– 25000 – 33000 kJ/kg
Petrol	– 45000 kJ/kg
Methane	– 50000 kJ/kg

Note:

- **Hydrogen have highest calorific value / highly efficient**
- **Hydrogen fuel cell is used to produce electrical energy**

Q) Even though hydrogen fuel has high calorific value it is not used as domestic fuel why? Ans)

- **It is highly explosive in nature**
- **It is difficult to store and transport hydrogen fuel**

Q) what are the properties a good fuel must have?

Ans)

- **Should be easily available**
- **Should be of low cost**

- **Should have high calorific values**
- **Should cause minimum atmospheric pollution on combustion**
- **Should be easily storable**
- **A liquid fuel does not evaporate quickly at ordinary temperatures.**

IV. POWER STATIONS

- **These are the places where power is produced in a commercial manner.**
- **There are mainly three types of power stations in India.**

Hydro Electric Power Station	Thermal Power Station	Nuclear Power Station
Potential energy → kinetic energy → mechanical energy → electrical energy	Chemical energy → heat energy → mechanical energy → electrical energy	Nuclear energy → heat energy → mechanical energy → electrical energy
Fuel: water	Fuel: coal, naphtha, lignite etc.	Radio active elements with nuclear fission
Example: Pallivasal, Kuttiadi Moolamattom etc.	Example: Ramagundam Kayamkulam, Neyveli etc	Example: Koodamkulam, kotta, Tharapur

RENEWABLE SOURCE OF ENERGY

SOLAR ENERGY

1. Electrical Energy from Solar

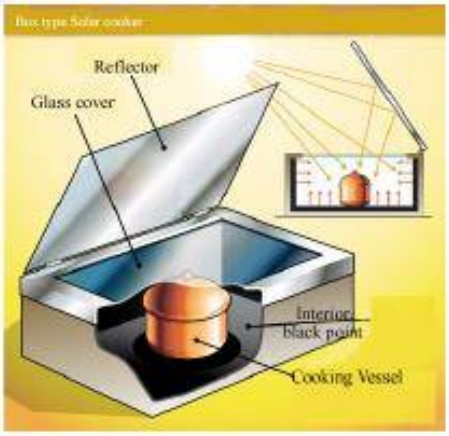
Solar cell is a means for converting solar energy into electrical energy. This is a p-n junction diode. When solar energy falls on N side of a solar cell, a small electric current is obtained due to the flow of electrons to P region from N region. This phenomenon is the photovoltaic effect. It is the electrical energy thus obtained that is stored in batteries and used whenever necessary.

2. Solar Panel

The voltage and current obtained from a solar cell is insignificant. A large number of solar cells are suitably assembled to form a solar panel. The electric current obtained from a large number of such cells can be stored in a battery and used as and when it is needed. Solar panel is used extensively in lighting street lamps. They are used to meet the energy requirement of artificial satellites. Nowadays solar photo voltaic (SPV) power plants capable of producing electricity of thousands of kilowatt are in use. The solar powerplant at the International Airport in Nedumbassery is an example.

The Solar Power Plant at the International Airport, Nedumbassery. The Power Plant takes care of the complete energy needs of the airport and the excess energy is given to KSEB. It received the Champion of Earth Prize – 2018 instituted by the United Nations for its use of Green Energy.

3. **Solar Cooker (Heat energy)**

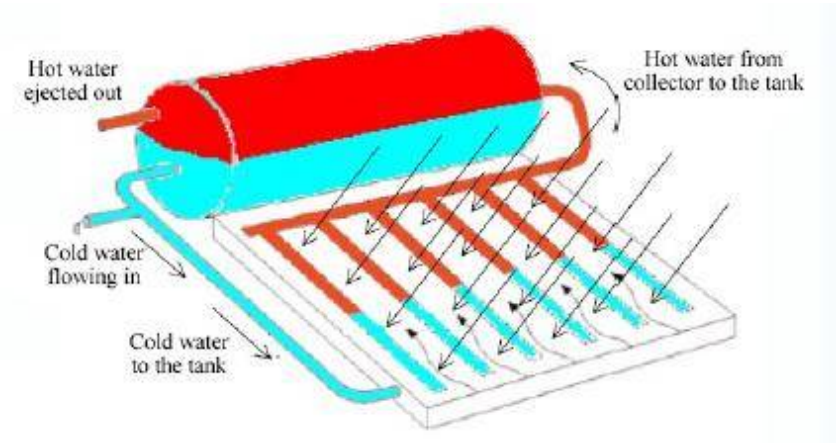


By concentrating heat radiation from sun in solar cooker using reflecting mirror at the black surface of the cooker the substance inside the cooker get heated.

Draw backs

- **It cannot be used in day time / rainy season**
- **It cannot used for frying vegetables/ meat/ fish**

4. **Solar Water Heater**



- **Solar radiations are concentrated on the copper pipe so water inside it get heated. The upper part of the tank contains hot water (in red colour) and lower part contain cold water (in blue colour)**

5. **Solar Thermal Power Plant**

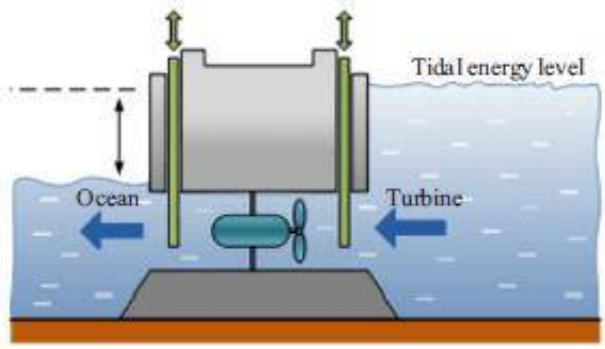
Solar thermal power plant generates electricity using solar energy. Concave reflectors are used to focus the sun's rays on the blackened pipes filled with water. As a result, water boils and vaporises. The steam rotates the steam turbine, so that the generator attached to the turbine is activated. About 10 such solar power plants are functioning in India, the majority of which are in Rajasthan.

<u>Energy from Wind</u>

Windmills: environment friendly, renewable. Energy is produced by rotating wind turbines

Draw backs: only at places where wind is available most of the time. High maintenance cost, difficult to have high storage batteries.

Tidal Energy



- **The gravitational pull between earth and moon cause tide.**
- **Tides of high altitude is needed to generate electricity.**
- **Water from higher energy level flows into lower energy level by rotating the turbine will create electrical energy.**

Ocean Thermal Energy

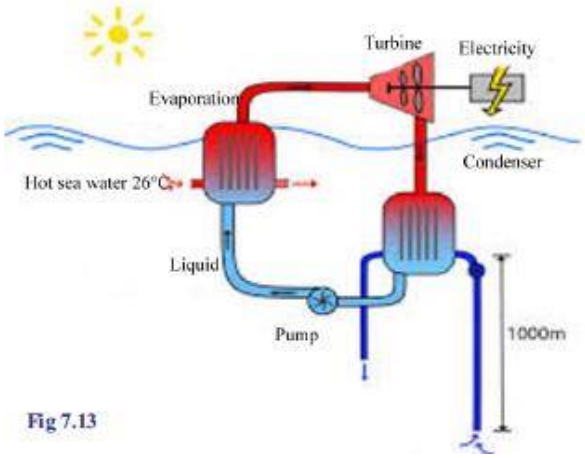


Fig 7.13

Difference in temperatures between surface water and water at a depth is the principle of working of OTECP.

Here volatile liquid ammonia gets evaporated at the surface of water and will rotate the turbine, it flows to the depth and get cooled. Again, the liquid ammonia gets pumped to the surface of sea and so on.

Geothermal Energy

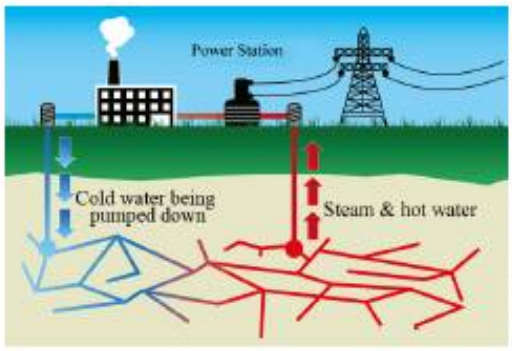


Fig 7.14

Though the surface of the earth has cooled down making it habitable, the interior is still in the molten form. Magma, which is at a higher temperature, comes out of the core through its softer regions. Such places are known as hot spots. Underground water at this place receives heat energy from the hotspot and is converted into steam. This steam, which is confined to the region between rocks, is brought out by drilling pipes through the rocks. Using this steam, turbine is rotated to produce electricity.

Note:

In kerala energy from tides, waves, geothermal energy are not possible because kerala's geographical conditions are not favourable to these energy production.

Energy from Nucleus

Nuclear Fission	Nuclear Fusion
The nuclei of greater mass are split into lighter nuclei, using neutrons.	Lighter nuclei are combined to form larger nuclei.
There is a loss of mass in this process and it is converted into energy ($E = mc^2$) m- mass loss, c – speed of light in vacuum.	There is a loss of mass in this process and it is converted into energy ($E = mc^2$) m- mass loss, c – speed of light in vacuum
Working principle of atom bomb	Working principle of hydrogen bomb
Nuclear reactors/ power plant uses this principle	The shining of stars (sun) is based on nuclear fusion

Note:

- nuclear reactor is a system that convert nuclear energy into electrical energy
- enriched uranium is used as fuel in nuclear reactors
- dangerous radioactive radiations are produced in nuclear reactors.

Nuclear Pollution

The pollution caused by radioactive substances and radiations in water, air and environment is known as ***Nuclear Pollution.***

Natural and man-made nuclear hazards

Natural	Man made
• Cosmic rays from outer space • Radiations from radioactive materials on the Earth	• The use of radioactive isotopes in the medical field. • Wastes from nuclear reactors.

Q) what are the precautions to be taken to face nuclear hazards?

- Shift out to safe places (Concrete buildings, buildings constructed using bricks etc)
- Strictly follow the directions from the concerned authorities
- Observe the symbols showing the nuclear radiations and behave accordingly.
- Reduce the density of population in places likely to experience nuclear hazards.
- If necessary, consume potassium iodide tablets or take food rich in iodine.

Fig 7.17
Symbol showing warning against nuclear radiation

Renewable energy resources	Non renewable energy resources
Do not cause pollution	It will cause pollution
Example: energy from sun, wind, tide, rain	Example: petroleum, coal, natural gas etc.

Green Energy	Brown Energy
Energy produced from natural source	Man made energy
Does not cause environmental pollution	Cause environmental pollution
Example: solar energy, wind energy, biomass, hydro electric power station, tidal energy	Example: petroleum, coal, nuclear energy, diesel engines, thermal power stations

What must be done to ensure maximum utilization of green energy while constructing a house?

- Sufficient sunlight should be available in the rooms during day time.
- Comfortable warmth, coolness and air circulation must be available without the help of electricity.

Energy Crisis

'Energy crisis is the consequence of increasing demand but decreasing availability'

Q) How will you reduce energy crisis?

Ans)

- **judicious utilisation of energy**
- **maximum utilisation of solar energy**
- **minimising the wastage of water**
- **making use of public transport**
- **controlling of street lamps with LDR**
- **timely maintenance of machine**
- **limiting the size of newly constructed buildings**
- **ensuring maximum efficiency of machines**
- **awareness**