UNIT – 1 SOLAR ENERGY

1. Define solar constant.

It is the amount of energy received in unit time on a unit area perpendicular to the sun's direction at the mean distance at the earth from the sun.

2. Define Beam radiation and diffuse radiation.

Beam radiation - Solar radiation that has not been absorbed or scattered and reaches the ground directly from the sun is called "direct radiation" (or) Beam radiation.

Diffuse radiation - It is that solar radiation received from the sun after its direction has been changed by reflection and scattering by the atmosphere.

3. Define hour angle.

It is the angle through which the earth must turn to bring the meridian of a point directly in the line with the sun's rays. It is equivalent to 15 º per hour.

4. What is Zenith angle?

It is a vertical angle between. the sun's rays and a line perpendicular to the horizontal plane through the point. It is 1t denoted as θ_z and $\theta_z = \pi/2 - \alpha$

where α = solar altitude.

5. What is pyrheliometer and pyranometer?

1. Pyrheliometer is an instrument which measures the beam radiation.
2. Pyranometer is an instrument which measures the total or global radiation over a hemispherical field of view.

6. What is the use of sunshine recorder?

The duration of bright sunshine in a day is measured by means of a sunshine recorder.

7. Define Local Apparent Time.

The time used for calculating the hour angle ω is the local apparent time. It can be obtained from the standard observed on a clock by applying two corrections.

8. What is total radiation?

Beam and diffuse component of solar radiation are absorbed in flat plate type collectors.

9. What are the two types of flat plate type solar collector?

1. Non-concentrating or flat plate type solar collector.
2. Concentrating (focusing) type solar collector.

10. What is angle of incidence?

It is the angle between the incident beam (I_{bn}) and normal to surface (s). It is shown in fig

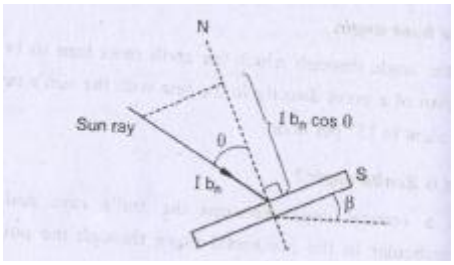

Fig 1.1 Angle of incidence

11. What is angle of latitude?

The angle between the equatorial plane of earth and the line joining the point on the earth's surface and the earth's centre.

12. Explain angle of declination (δ).

It is the angle between the line joining centre of the sun and earth and the equatorial plane.

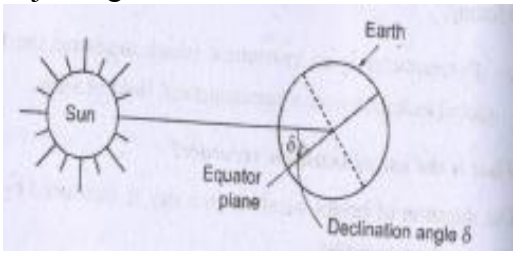

Fig 1.2 Angle of declination

13. What are the two different types of air heaters?

1. Non-porous absorber.
2. Porous absorber.

14. What are the applications of solar air heaters?

It is used in:

1. Heating buildings
2. Drying agricultural product and lumber
3. Heating green houses

15. What are the different losses occurs during performance calculation of collector efficiency?

1. Conductive losses.
2. Convective losses.
3. Radiation losses.

16. What are the different types of concentrating collectors?
    1. Line focusing, and
    2. Point focusing type.

17. What are the main types of concentrating collectors?
    1. Parabolic through collector.
    2. Mirror strip reflector.
    3. Fresnel lens collector.
    4. Flat plate collector with adjustable mirrors.

18. What are the components of photo-voltaic system?
    1. Solar cell array.
    2. Load leveler.
    3. Storage system.
    4. Tracking system.

19. What are the different types of solar photo voltaic arrays?
    1. Flat-plate Arrays.
    2. Concentrating Arrays.

20. What are the applications of solar photovoltaic system?
    1. Water pumping sets for micro irrigation and drinking water supply.
    2. Weather monitoring.
    3. Railway signaling equipment.

21. What are the advantages of photovoltaic conversion?
    1. Absence of moving parts.
    2. They are highly reliable.
    3. They have a long effective life.
    4. They do not create pollution.

22. What are the disadvantages of solar energy conversion?
    1. It is costly
    2. It requires energy storage
    3. It needs no insolation at night.

23. Define Concentration ratio.

$$\text{Concentration ratio (CR)} = \frac{\text{kW/m}^2 \text{ in solar radiation on surface}}{\text{kW/m}^2 \text{ on surface of focus of collector}}$$

24. What are the different types of solar thermal collectors?
    1. Flat plate collectors.
    2. Modified flat-plate collectors
    3. Paraboloidal dishes
    4. Parabolic through

25. What are the characteristic features of a collector?

1. Low temperature, medium temperature, and high temperature.
2. Non-tracking type (or) tracking in one plane or tracking in two planes.
3. Distributed receiver collectors (or) central receiver collectors.

26. What is Absorption/Reflection ratio (α/ε)?

It has significant effect on the temperature attained by the heat transport fluid.

27. What Collector Efficiency

$$\text{Collector Efficiency} = \frac{\text{Energy collected by the collector (J)}}{\text{Energy incident on the collector (J)}}$$

28. What is shadow factor?

$$\text{Shadow factor} = \frac{\text{Surface of the collector receiving light}}{\text{Total surface of the collector}}$$

29. What is cosine Loss factor?

For maximum power collection, the surface of collector should receive the sun rays perpendicularly. If the angle between the perpendicular to the collector surface and the direction of surface and direction of sun ray is θ, the area of solar beam intercepted by the collect surface is proportional to cos θ.

30. Define Reflective loss factor.

The Collector glass surface and the reflector surface collect dust, dirt, moisture. The reflector surface gets rusted, deformed and losses the shine. Hence, the efficiency of the collector is reduced significantly with passage of time.

31. What is Heliostats?

'Heliostats' are large, flat reflecting mirrors with a provision to track the sun in two planes. The solar rays are reflected by each individual heliostat on to the central receiver mounted on a tall tower. Central receiver mounted on a tall tower.

32. What is the efficiency of a solar cell?

$$\text{Efficiency of a solar cell} = \frac{\text{Electrical power output}}{\text{Power intercepted}}$$

33. What are the three different types of 'Homojunction' PV cells?

PV cells which have only silicon as the base for PN junction are called ‘‘Homojunction’ PV cells. They are:

1. Amorphous.silicon
2. Poly crystalline silicon
3. Single crystal silicon

34. What is 'crystal growing'?

Crystals have highly ordered atomic and molecular structure. The process of converting poly-crystalline silicon to the single crystal silicon is called' crystal growing '.

35. What are the different types of,PN junction?

1. Cadmium sulphide
2. Gallium-arsenide.
3. Zinc-sulphide.
4. Gallium-antimonide

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UNIT – 2 WIND ENERGY

1. What is wind energy?

Wind energy is an indirect form of solar energy.

2. Write down the applications of wind power.

1. Wind turbines to make electricity
2. Windmills for mechanical power
3. Wind pumps for water pumping or drainage, and
4. Sails to propel ships.

3. Mention characteristics of wind energy.

1. Wind-power systems do not pollute the atmosphere. .
2. Fuel provision and Transport are not required Wind-power systems.
3. Wind energy is a renewable source of energy.
4. Wind energy when produced on small scale is cheaper, but competitive with conventional power generating system when produced on a large scale.

4. Write down the characteristic of wind speed.

1. Cut-in wind speed: when the machine begins to produce power
2. Design wind speed: When the windmill reaches its maximum efficiency
3. Rated wind speed: when the machine reaches its maximum output power
4. Furling wind speed: when the machine furls to prevent damage at high wind speeds.

5. Obtain the distribution profile of wind speed.

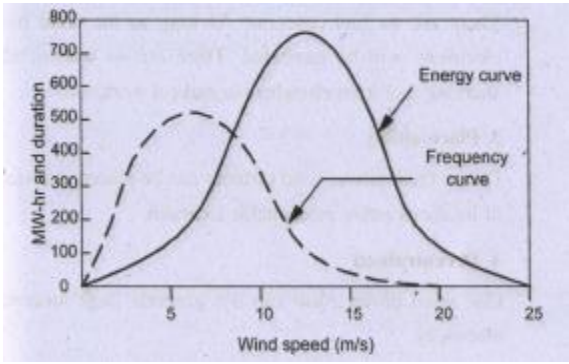

Fig 2.1 Distribution of wind speed

6. List down the wind economics determining factors.

1 .Wind Resource
2 .Financing and Ownership Structure
3 .Taxes and Policy incentives by the Government
4 .Plant Size: equipment, installation, operation and maintenance economies of scale
5 .Turbine size, model, and tower height
6 .Green field or site expansion
7 .Land, transmission and ancillary services.

7. Mention various advantages of wind power .

1. Clean: Aside from the manufacturing process, wind power emits absolutely no greenhouse gases.
2. Free: There is no fuel -concerns. As long as the wind blows, electricity will be generated. There are no worries about sourcing fuel from elsewhere to make it work.
3. Place-ability: Due to their nature, wind turbines can be placed in a variety of locations rather inhospitable locations.
4. Decentralized: One wind power plant can not generate huge amount of electricity.
5. Domestic: Wind power lends itself well to domestic applications, as wind turbines can be virtually any size.

8. What are tile disadvantages of wind power?

1. Reliability: Wind power needs wind. There is not always wind available. The turbines need minimum wind speed to get them spinning, and can only operate up to a maximum wind speed, after which they have to be locked
2. Expense: Wind turbines are quite expensive, especially as you need so many to match the output of a regular power station.
3. National Security: There was a recent discovery that wind power can even affect national security.
4. Wildlife: There have long been arguments that wind turbines affect migratory birds, but more recently it has been discovered that they can make bats' lungs explode.
5. Aesthetics: This one really is down to personal taste. But it should be included here because farms have often been banned for exactly this reason.

9. State the characteristics of lift and drag.

1. Drag is in the direction of airflow.
2. Lift is perpendicular to the direction of airflow.
3. Generation of lift always causes a certain amount of drag to be developed with a good aerofoil.
4. The Ii produced can be thirty times greater than the drag.
5 .Lift devices are generally more efficient than drag devices.

10. Draw the graph between wind power density and velocity.

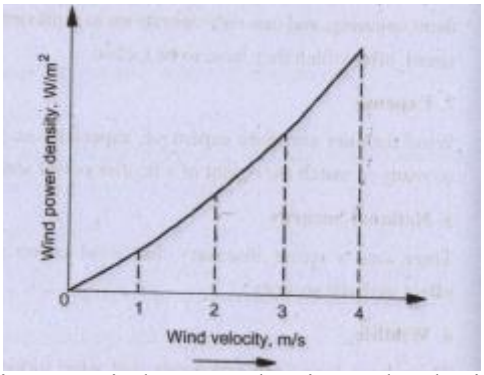

Fig 2.2 Wind power density and velocity

11. Classify wind mills.

1. Multiple blade type
2 .Savonius type
3. Darrieus type

12. What are the components of wind energy system?

a) Windmill
b) Wind turbines
c) Towers
d) Hybrid system combinations
e) Pump/motor
t) Storage
g) Energy converters
h) Balance of system

13. List down the performance factors in wind energy generators.

1. Solidity
2. Tip Speed Ratio
3 . Performance Coefficient
4 .Torque

14. Define solidity.

Solidity is defined as the percentage of the circumference of the rotor which contains material instead of air.

15. What is tip speed ratio?

It is defined as the ratio of the speed of the blade tip of a windmill rotor to the speed of the free wind. This is a measure to know the gearing ratio of the rotor.

16. Write down the formula of tip-speed ratio.

Tip-speed ratio = 0.052 x Rotor diameter x Rotation speed x Wind Speed

17. Define performance coefficient related to wind machine.

The coefficient of performance (K_p) is a function of tip speed ratio which is normally used to classify rotor.

$$K_p = \frac{\text{Power delivered by the rotor}}{\text{Maximum power available in the wind}}$$

K_p does not exceed 0.593 for horizontal axis wind machine.

18. State the various parts of a wind-electric generating power plant.

1 .Wind turbine (or) Rotor
2 .Wind mill head-it houses speed .increaser, drive shaft, clutch, coupling etc..
3 .Electrical generator
4 .Supporting structure.

19. Write the functions of wind mill head.

1. It supports the rotor housing and the rotor bearings.
2. It also houses any control mechanism incorporated like changing the pitch of the blades for safety devices and tail vane to orient the rotor to face the wind, the latter is facilitated by mounting it on the top of the supporting structure on suitable bearings.

20. Classify wind turbines.

1. Horizontal axis wind machines 2. Vertical axis wind machines.

21. Obtain the variation of performance coefficient with-tip speed ratio.

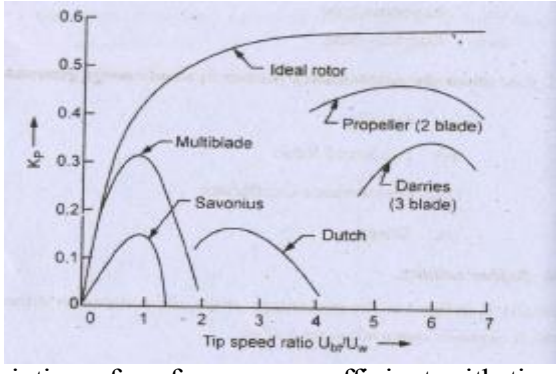

Fig 2.3 Variation of performance coefficient with-tip speed ratio

22. Mention any four advantages of HAWT.

1. Variable blade pitch which gives the turbine blades the optimum angle of attack.
2 .The tall tower bases allow access to stronger wind in sites with wind shear.
3 .High efficiency, since the blades always moves perpendicularly to the wind, receiving power through the whole rotation.
4. The face of a horizontal axis blade is struck by the wind at a consistent angle regardless of the position in its rotation.

23. State any four disadvantages of HA WT.

1. Massive tower construction is required to support the heavy blades, gearbox, and generator.
2. Reflections from tall HAWTs may affect side lobes radar installations creating signal clutter, although filtering can suppress it.
3.Their height makes them obtrusively visible across large areas, disrupting the appearance of the landscape sometimes creating local opposition.
4.Downwind variants suffer from fatigue and structural failure caused by turbulence when a blade passes through the tower's wind shadow.

25. Classify wind power plants.

1 .Remote wind power plants
2 .Hybrid wind power Plants
3 .Small wind turbines
4 .Grid connected wind power plants
5 .Wind farms
6 .Wind-powered battery chargers

24. Write down any two advantages and disadvantages of VAWT.

Advantages:

1. VAWTs may be built at locations where taller structure is prohibited.
2. VAWTs situated close to the ground can take advantage of locations where mesas, hilltops, ridgelines, and passes funnel the wind and increase wind velocity.

Disadvantages:

1. The stress in each blade due to wind loading changes sign twice during each revolution as the apparent direction moves through 360 degrees.
2. While VAWTs' parts are located on the ground, they are also located, under the weight of the structure above it which can make changing out parts nearly impossible without dismantling the structure if not designed properly.

26. Draw the layout of wind energy storage system.

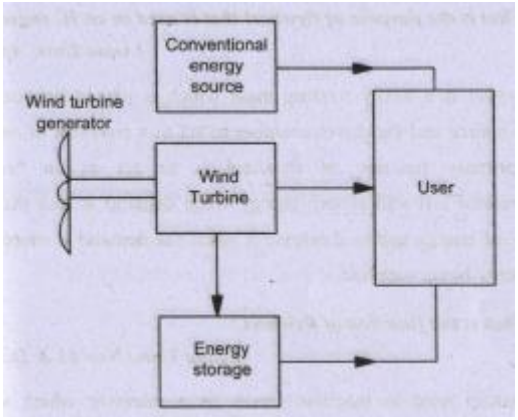

Fig 2.4Wind energy storage system.

27. What are the advantages of pumped storage plants?

a) It is free from effects of environment pollution.

b) Such plants are readily adoptable to automation as well as remote control.

28. What are the different operating cycles of pumped storage plants?

a) Daily peak load operation.

b) Week-end storage, weekly operation

c) Storing during rainy season, yearly operation.

29. What are the different types of pumped storage power plants?

The pumped storage plants are classified as

a) Over ground High Head/Medium Head/Low Head

b) Under ground High Head/Medium Head/Low Head

30. What is the purpose of flywheel that is used in all IC engine?

A flywheel is a heavy rotating mass which power source and the driven member to act as a reservoir of energy. The primary function of flywheel is to act as an "energy accumulator". It will absorb energy when demand is less than the supply of energy and will release it when the demand is more than the energy being supplied.

31. What is the function of flywheel?

A flywheel used in machine serves as a reservoir which store energy during the period when the supply of energy is more than the requirement and releases it dulling the period when the requirement of energy is more than the supply.

32. Mention the sites selected to install-wind mills.

(i) Plane sites (iii) Sea-shore sites

(ii) Hill top sites (iv) Off-shore shallow water sites

33. What are the applications of flywheel?

In some cases, the power is supplied at a uniform rate, while the requirement of power from the driven machinery is variable. Example: Punching press driven by an electric motor, rolling mill driven by an electric motor. In these cases, the flywheel stores energy during the idle portion of the work cycle by increasing its speed and delivers this energy during the peak load period of punching.

34. What are the factors to be considered for installing wind mills?

1. Wind farms are located away from main cities due to the resistance to the air movement created by buildings.
2. Wind power is based on the wind velocity. So, the flat area is advisable to locate wind mill.
3. The site which provides average of wind velocity throughout the year for continuous generation of energy.
4. The proposed site should be checked for higher altitude for the reason of strong winds which will increase the electric power output of wind energy conversion system.
5. Stable ground is selected.
6. Small trees and· grass are avoided under wind mill in order to minimize the installation cost because the height of tower will increase in this case.
7. The selected site should be easily accessible to provide transport facility for the erection of equipment and structures.
8. The site should be near to the consumer for reducing the cost and transmission losses.
9. The site cost should be favorable.

35. State the various applications of wind energy.

1. Wind Energy used in Water Pumping
2 .Systems for Community Centers, Schools, and Health Clinics
3 .Wind energy used in Heating and cooling processes
4 .Wind energy used in electricity generation
5. Industrial Applications

36. List down the main industrial applications wind energy

1 .Telecommunications
2 .Radar
3 .Pipeline control
4 .Navigational aids, such as ship with sails
5 .Cathode protection
6 .Weather stations/seismic monitoring
7 .Air-traffic control.

37. Mention the various hybrid systems used in wind power generation.

1 .Combined pumped storage wind and steam power plant
2 .Combined wind-diesel power plants
3 .Combined biomass-wind-fuel cell system
4. Combined photovoltaic-wind system
5. Combined wind-hydrogen system
6 .Combined wind-compressed air systems

38. List down the components of combined pumped storage wind and steam power plant.

1 .Upper basin 2 .Pressure conduit 3 .Base load steam plant
4 .Turbine 5 .Motor or generator 6 .Pump

UNIT – 3 WIND ENERGY

1. What is Biomass and Biomass energy?

Biomass is organic matter produced by plants, both terrestrial (those grown on land) and aquatic (those grown in water). E.g., Wood and Agriculture residue. The energy obtained from biomass is called biomass energy.

2. What are the two major classifications of biomass resources?

1. Biomass from cultivated fields, crops, forests and harvested periodically.
2. Biomass derived from waste e.g., municipal waste, animal dung, forest waste, agricultural waste, bioprocess waste.

3. What is the scope of biomass energy?

1. Rural application of biomass energy.
2. Urban and industrial applications of biomass energy.
3. Biomass as a primary source for large scale electrical power generation.

4. What are the different types of biomass waste?

1 .Urban waste.
2 .Process waste.
3 .Agricultural waste.
4 .Forest waste.
5 .Fishery, Poultry.
6 .Animal and human excreta.

5. What are the major categories of biomass conversion process?

1. Direct combustion (Incineration)
2. Thermo chemical conversion.
3. Biochemical conversion.

6. What is fermentation?

It is the breakdown of complex molecules in organic compound under the influence of ferment, such as yeast, bacteria, enzymes, etc.

7. What are the factors affecting biodigestion or generation of gas?

1. pH or the hydrogen-ion concentration
2. Temperature.
3. Total solid content.
4. Loading rate.
5. Seeding.
6. Diameter to depth ratio.
7. Nutrients.
8. Type of feed stocks.
9. Pressure.
10. Uniform feeding.

8. Define pyrolysis.

Biomass can be converted into gases, liquids and solids through pyrolysis at temperature of 500-900°C by heating in a closed vessel in the absence of oxygen.

9. What are two biochemical conversions?

1. Anaerobic digestion.
2. Fermentation.

10. Define anaerobic digestion.

It is a type of biochemical conversion involving microbial digestion of biomass. It generates methane and $C0_2$ gas.

11. Define photosynthesis.

1 .Photosynthesis means synthesis with light.

2 .Photosynthesis converts solar energy into biomass energy.

3 .It consists in building up of simple carbohydrates, such as sugar in the green leaf in presence of sunlight.

12. What are the necessary conditions for photo-synthesis process?
    1. Light: It is one of the important inputs for biomas production.
    2. $C0_2$ concentration: It is the primary raw material for photo synthesis.
    3. Temperature: Photosynthesis is restricted temperature range 0°C to 60°C.

13. What are the classifications of biogas plants?
    1. Continuous and batch types.
    2. Dome and drum types.
    3. Different variations in the drum type.

14. What is Gobar gas?

Biogas produced from cow dung in a plant is called biogas. It is used in cooking, lighting, running diesel engines, fuel for furnaces.

15. What is anaerobic digestion?

It is the process of making complete digestion of a biomass. It is applicable to wet organic matters. The process involves microbial digestion of biomass. An anaerobe is microorganism which lives and grows on biomass at low temperature (<65°C).

16. What is the average composition of biogas?
    Methane (CH_4) - 55 to 60%
    Carbon dioxide ($C0_2$) - 35 to 40%
    Hydrogen (H_2) 5%
    H_2Sand 0_2 – Traces

17. What are the main features of continuous type gas plant? .
    1. It will produce gas continuously.
    2. It requires small digestion chambers:
    3. It needs lesser period for digestion.

18. What are the main features of the batch type gas plant?
    1. The gas production is intermittent.
    2. It needs several digesters.
    3. Batch type plants are good for long fibrous materials.

19. What are the materials used for bio-gas generation?
    1. Animal wastes.
    2. Human wastes.
    3. Agricultural wastes.
    4. Waste of aquatic origin.

20. What is Gasifier?

It is equipment which can gasify a variety of biomass, such as wood waste, agricultural waste, such as stalks, and roots of various crops, maize cobs, etc.

21. What are the advantages of a gasifier?

1. It is very easy to operate the gasifier.
2. Maintenance is easy.
3. It is reliable in operation.

22. What is the classification of biomass gasifier?

1. Small size gasifier.
2. Medium size gasifier.
3. Large size gasifier.
4. Very large gasifier.

23. What are the three major designs of fixed bed gasifier?

1. Up draught.
2. Down-draught.
3. Cross draught.

24. What is equivalence ratio?

$$\text{Equivalence ratio (ER)} = \frac{\text{Weight of oxygen/Weight of dry fuel}}{\text{Weight 0f oxygen n/Weight 0f dry fuel}}$$

25. What are the advantages of fluidized bed gasifier?

1. It has good heat storage capacity.
2. Consistent rate of combustion is obtained.
3. Output rate is high.

26. What is pyrolysis?

It is an irreversible chemical change caused by the action of heat in absence of oxygen. This process may yield solid, liquid or gaseous fuel.

27. What is hydrolysis?

Hydrolysis is the technology which converts cellulose into alcohols through fermentation.

28. What is Algae?

Algae are group of botanical plants mostly single celled. They are of subkingdom Thallophyta. Algae contain chlorophyll and other red, brown, pigments. Algae are found in water, in dams, in the form of sea-weeds, in ponds, lakes.

29. What are the applications of the gasifier?

The gasifier technology has a tremendous potential in terms of its applications as the process outputs can be converted into electrical, mechanical and/or heat energy.

30. What are all the gasification equipment?

1. Updraft reactor.
2. Downdraft reactor.
3. Fluidized bed reactor.

31. What are the steps in biodiesel production?

1. Feedstock pretreatment.
2. Reactions.
3. Product purification.

32. What are the reactions in biodiesel production?

1. Transesterification.
2. Base-catalyzed transesterification mechanism.

33. What are the biodiesel production methods?

1. Batch process.
2. Supercritical process.
3. Ultra and high-shear in-line and batch reactors.
4. Ultrasonic reactor method.
5. Microwave method
6. Lipase –catalyzed method

UNIT – 4 OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY

1. What is the principle of OTEC?

The ocean water gets heated up naturally due to solar radiation .The temperature of water near surface is higher than that of water. Significant amount of heat can be extracted from water by ocean thermal gradient principle of thermodynamics.

2. What are the different types of OTEC?

a) Open cycle (Claude cycle, Steam cycle)
b) Closed cycle (Anderson cycle, Vapour cycle)

3. What are the limitations of open cycle OTEC system?

a) Very large flow of ocean water in terms of and volume.
b) Cost of plant is high.
c) Turbine is physically large.
d) Cost of electrical energy from open cycle OTEC is very high.

4. What are the working fluids in closed cycle OTEC?

a) Ammonia (NH3)
b) Freon
c) Butane

5. What are the components of Tidal power plants?

1. The dam or dyke
2. Sluice ways
3. The power house

6. What is the basic principle of Tidal power?

Tides are produced mainly by the gravitational attraction of the moon and the sun on the water of solid earth and the oceans. About 70%of the tide producing force is due to the moon and remaining 30% is due to the sun.

7. How can the generation of power be achieved in a single basin arrangement?

The power generation in a single basin arrangement can be achieved by anyone of the following systems.

a) Single ebb-cycle system, or
b) Single tide-cycle system, or
c) Double cycle system

8. What is the classification of tidal power plants?
    1. Single basin arrangement
        a) Single ebb-cycle system, or
        b) Single tide-cycle system, or
        c) Double cycle system
    2. Double basin arrangement

9. What are the advantages of Tidal power generation?
    a) Tidal power is in exhaustible.
    b) Free from pollution
    c) These power plants do not demand large area of valuable land.

10. What are the limitations of tidal power generation?
    a) The tidal ranges are highly variable and thus the turbines have to work on a wide range of head variation.
    b) Construction in sea is found difficult.
    c) Cost is not favorable when compared to the other sources of energy.

11. What is geothermal energy?

Geothermal energy is the heat from high pressure steam coming from within the earth. It is a renewable source of energy derived from the rain water in the earth heated to over 180°C by Subterranean hot rocks.

12. What are the applications of geothermal energy?
    a. Generation of electric power
    b. Space heating for buildings
    c. Industrial process heat.

13. Give some geothermal energy sources in India.
    1 .Puga Valley of the Ladakh region in Jammu and Kashmir.
    2 .Cambay region of Gujarat and Maharastra.
    3 .Tattapani-Hydro-Geothermal field, Madhya Pradesh.

14. What are the different geothermal fluids?
    a) Hot water
    b) Hot brine
    c) Wet stream
    d) Mixture of above.

15. What are the forms of geothermal energy stored deeply inside the earth?
    a) Hot water springs
    b) Fumaroles.
    c) Volcanic eruptions.

16. What are the important criteria while selecting the geothermal energy?
    a) Temperature of geothermal fluid, °C.
    b) Discharge rate, m^3/day
    c) Useful life of production well, years
    d) Mineral contents gram/m^3

17. What are the different types of geothermal energy deposits?
    a) Hydro-geothermal energy resources
    b) Petro-geothermal energy deposits
    c) Hot-dry rock.

18. What are the different geothermal fluids for electrical power plants?
    a) Dry steam - Steam-Turbine cycle.
    b) Hot water, temperature> 180°C - Steam-Turbine cycle .
    c) Hot water, temperature <150°C - Binary-cycle
    d) Hot brine (pressurized) - Binary-cycle
    e) Hot brine (flashed) - Special turbines
        - Impact turbine
        - Screw expander
        - Bladless turbine

19. Give the classification of geothermal electrical power plants.
    1. According to Geothermal Energy Resource.
        a) Geothermal steam
        b) Geothermal brine
        c) Geothermal hot water
        d) Hot rock.
    2. According to Thermodynamic cycle
        a) Steam Turbine cycle
        b) Binary cycle
        c) Total flow concept

20. What are the different types of turbines for driving generator rotor in geothermal power plants?
    a) Steam turbines
    b) Gas turbine
    c) Impact turbine driven by brine.
    d) Helical screw expander
    e) Bladeless turbine

21. What are the different working fluids in Binary Cycle geothermal power plants?
    1. lsobutane (C_4H_{10})
    2. Ammonia
    3. Propane
    4. Freon-12

22. What are the different types of small scale hydro electric turbines?
    1. Bulb or Tubular turbine.
    2. Tube Turbine.
    3. Straflo Turbine.

23. What are the classifications of geothermal fields?
    1. Non thermal areas - Temperature gradient 10 -40°C/km depth.
    2. Semi-thermal areas- Temperature gradient - 70°C/km depth.
    3. Hyper-thermal areas -Temperature gradients are many times greater than in normal areas

24. What is Geo pressured resources?

Drilling for oil and gas has revealed the existence of reservoirs containing salt water at moderately high temperatures and very high pressures in a belt some 1200 km in length.

25. What is Magma Resources?

In some cases, especially in the vicinity of relatively recent volcanic activity molten or practically molten rock occurs at moderate depth. The very high temperature above 650°C and the large volume make magma a substantial geothermal resource.

26. What are the arrangements for hybrid plants?
    1. Geothermal preheat.
    2. Fossil superheat.

27. What are the different types of prime-movers for Geothermal Energy Conversion?
    1. Impulse/Reaction Machines
        (a) Axial flow -Curtis, Rateau Steam Turbine.
        (b) Radial inflow - Francis turbine, multiple disc drag turbine.
        (c) Radial outflow Rotating nozzle.
        (d) Multiple disc turbine Bladeless impulse or reaction drag turbine
    2. Positive displacement machines
        (a) Helical, Screw expander.
        (b) Rotating, oscillating vane machine.
    3. Impulse machines
        (a) Tangential flow - peloton wheel, re-entry type turbine.
        (b) Axial flow, De-laval turbine, Curtis turbine.

28. What are the applications of Geothermal Energy?
    1. Generation of electric power.
    2. Industrial process heat and
    3. Space heating for various kinds of buildings.

29. What are the impacts of fossil fuel power plant?
    1. Land use and waste management.
    2. Water management.
    3. Air pollution management.

30. What are the major environmental concerns of wind energy?
    1. Noise.
    2. Visual impacts.
    3. Avian/Bat Mortality.

UNIT – 5 NEW ENERGY SOURCES

1. Define electrolysis process.

The hydrogen and oxygen in water can be dissociated with an electric current in a process called electrolysis.

2. List down the chemical properties of hydrogen

1) It readily combines with oxygen to form water.
2) It has high energy content per weight.
3) Hydrogen is highly flammable.
4) Hydrogen bums with a pale-blue, almost-invisible flame, making hydrogen fires difficult to see.
5) The combustion of hydrogen does not produce carbon dioxide (C02), particulate, or sulphur emissions. It can produce nitrous oxide (NO_x) emissions under some conditions.
6) Hydrogen can be produced from renewable resources, such as by reforming ethanol and by the electrolysis of water.

3. What are the methods of producing hydrogen?

1 .Steam reforming
2 .Electrolysis
3 .Steam electrolysis
4 .Thermo chemical water splitting
5 .Photo-electrochemical system
6 .Photo-biological system
7 .Biological system.

4. State the advantages of using high pressure electrolyser.

1. Reduction in specific power consumption
2. Delivery of gas to eliminate the cost gas compressors
3. Reduction in the size of electrolysis cells

5. Draw a sketch of a simple electrolyte cell.

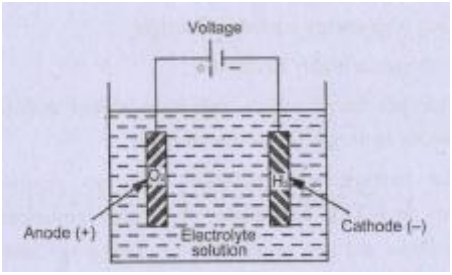

Fig 5.1A simple electrolyte cell

6. Classify the arrangement of electrode
    1. Tank type or unipolar electrolyser
    2. Filter press or bipolar electrolyser

7. Mention the various advantages of tank type electrolyser.
    1. Easy maintenance
    2. Easy replacement of particular cells

8. Draw the layout of a Westinghouse Sulphur Cycle.

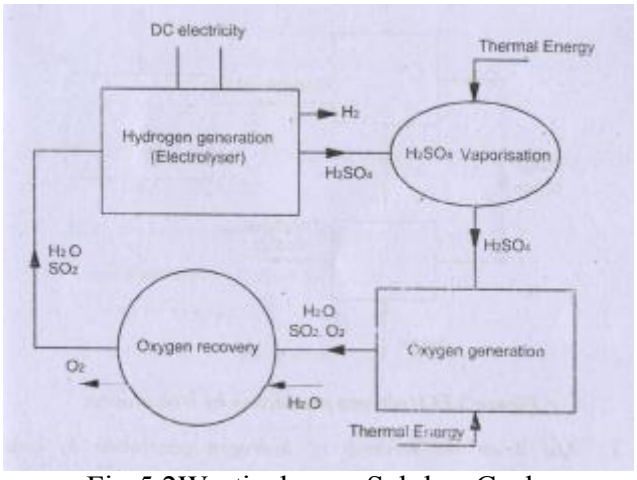

Fig 5.2Westinghouse Sulphur Cycle

9. Draw the general layout of Hydrogen Generation by Iron

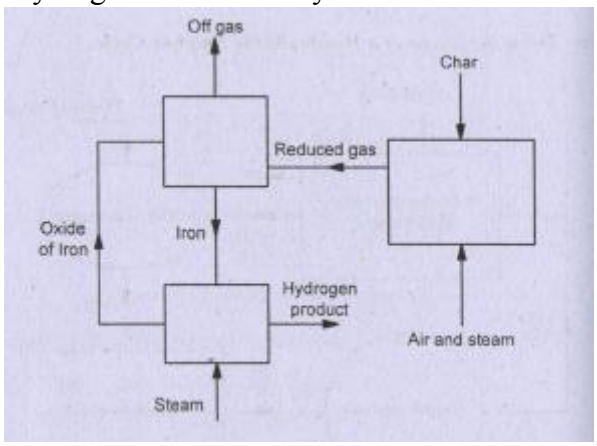

Fig 5.3Hydrogen production by Iron process

10. List down the methods of hydrogen generation by coal gasification process.
    (i) Steam Gasification
    (ii) Hydro-gasification

11. What are the two Photolytic methods in hydrogen generation?
    (a) Photo-biological method where microbes produce hydrogen when exposed to light, (b) Photo-electrolysis, where special metals, when exposed to light and submersed in water, generate enough electricity to generate hydrogen by splitting the water.

12. What is meant by hybrid-electrolysis process?
    The solar thermal power is coupled with electrolysis process called hybrid-electrolysis process.
13. State the various modes of hydrogen storage.
    1. Compressed gas storage
    2. Liquid storage
    3. Line pack storage system
    4. Underground storage
    5. Storage as metal hydrides

14. Mention challenges in hydrogen storage.
    1. Weight and Volume
    2. Efficiency
    3. Fuel cell cost and durability
    4. Refueling time
    6. Hydrogen Production and Delivery
    6. Public Acceptance
    7. Codes and Standards

15. Enlist the hydrogen transportation methods.
    1. Pipe lines
    2. Liquid hydrogen transportation
    3. Metal hydride transportation

16. Mention the advantages of hydrogen energy.

1. A fuel in H_2O_2 fuel cell system
2. Manufacturing synthetic Ammonia, synthetic Methanol and synthetic Urea or ammonium nitrate.
3. An aviation fuel by hydrogenation process.
4. Chemical reduction and various heating process.
5. A coolant in large generators and motors.
6. Processing natural gas, coal and Ammonia.
7. Used in the manufacturing of Tungsten filaments for lamps.
8. An alternate fuel in transport and energy carrier.

17. What is fuel cell?

A fuel cell is a device that uses hydrogen (or a hydrogen-rich fuel) and oxygen to create an electric current.

18. Draw a schematic of a fuel cell.

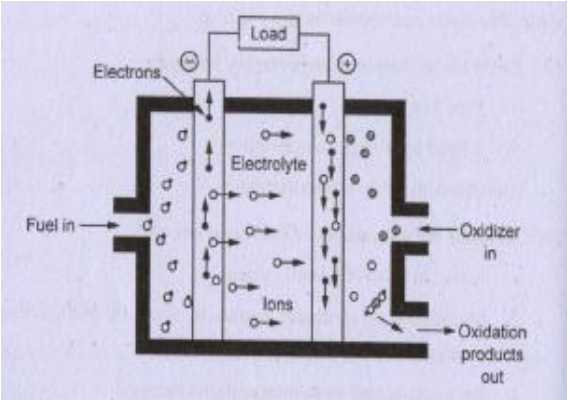

Fig 5.4Schematic of a fuel cell

19. Classify fuel cells.

1) Hydrogen-oxygen fuel cell
2) Polymer Electrolyte Membrane (PEM) Fuel Cell
3) Direct Methanol Fuel Cell
4) Alkaline Fuel Cell
5) Phosphoric Acid Fuel Cell
6) Molten Carbonate Fuel Cell
7) Solid Oxide Fuel Cell
8) Regenerative Fuel Cell

20. Mention the various parts of fuel cell.

1. Membrane electrode assembly
2. Catalyst
3. Chemistry of a Fuel Cell
4. Hardware

21. List down the major sections of a fuel cell.
    1. Fuel processing section
    2 .Fuel cell power pack
    3 .Power conditioning section
    4 .Switchgear and supply section
    5. Control subsystem section
    6 .Heating section.

22. What are the advantages of fuel cells?
    1) Fuel cells have the potential to replace the internal combustion engine in vehicles and . provide power for stationary and portable power applications.
    2) They can be used in transportation applications such as powering automobiles, buses, cycles, and other vehicles.
    3) Many portable devices can be powered by fuel cells, such as laptop computers and cell phones.
    4) They can also be used for stationary applications, such as providing electricity to power homes and businesses.

23. List down the fuel cell vehicles.
    1. Highway vehicles
    2. Other surface transportation
    3. Aerospace .
    4. Marine vehicles

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