What are the advanced collectors used in solar energy collections?

Ans- Advanced Collectors used in solar energy collection aim to maximize the efficiency of converting sunlight into usable energy. Some advance solar collectors include:

(i) PHOTOVOLTAIC (PV) PANELS: • They are one of the most common solar collectors.

• Advanced PV technologies, such as multi-junction solar cells and thin film solar cells are designed to improve efficiency and reduce manufacturing costs.

(ii) CONCENTRATED SOLAR POWER SYSTEMS- • It uses mirrors or lenses to concentrate sunlight onto a small area, typically heating a fluid that drives a turbine to generate electricity.

• Advance CSP systems may include parabolic troughs, solar power towers, and dish systems

(iii) CONCENTRATOR PHOTOVOLTAICS- • It uses lenses or mirrors to concentrate sunlight onto high-efficiency solar cells.

• It can significantly boost electricity generation in areas with abundant sunlight.

(iv) THERMOPHOTOVOLTAICS - • It convert heat into electricity by using selective emitters and specialized photovoltaic cells

• They have applications in waste heat recovery and concentrated solar power.

(v) NANO-STRUCTURED SOLAR CELLS- It can enhance light absorption and charge separation, potentially improving the efficiency of solar cells.

etc.

Differentiate aerobic and anaerobic biogas power plants. Draw the schematics also.

BASIS	AEROBIC BIOGAS POWER PLANT	ANAEROBIC BIOGAS POWER PLANT
OXYGEN REQUIREMENT	It requires O_2 for the decomposition of organic matter.	It operates in absence of O_2. organic matter is decomposed in absence of O_2.
DECOMPOSITION PROCESS	-microorganism break down organic matter relatively faster and more efficient	It is a slower process compared to aerobic digestion. The series of biochemical reactions carried out by anaerobic bacteria.
TEMPERATURE AND PH	It typically operates at higher temperature and requires near-neutral pH level	It typically operates at lower temperatures and can tolerate a wider PH range.
OUTPUT GAS COMPOSITION	The gas produced is primarily composed of CO_2 and H_2O with lower CH_4.	The gas produced is primarily composed of CH_4 and CO_2 with CH_4 being the main component
BYE PRODUCTS	It produces nutrient-rich byproducts like compost, which can be used as a soil conditioner or fertilizer.	It produces digestate which can be used as soil conditioner of fertilizer.

what is the significance of solar constant

Ans- The significance of solar constant are-

(i) It measures the amount of energy received by a given area one astronomical unit away from the sun.

(ii) It is a flux density measuring mean solar electromagnetic radiation per unit area.

(iii) It is measured on a surface perpendicular to the rays, one astronomical unit from the sun.

(iv) The solar constant includes radiation over the entire electromagnetic spectrum.

(v) This constant is used in the calculation of radiation pressure, which aids in calculation of a force on a solar sail

(vi) It is measured by satellite as being $1.361\ kW/m^2$ at solar minimum

(vii) It is not a physical constant in the modern CODATA scientific sense, that it is not like the planck constant or the speed of light which are absolute constant in physics.

(viii) It is used to quantify the rate at which energy is received upon a unit surface such as solar panel.

(ix) It is used in various atmospheric and geological sciences, though called a constant, merely relative constant.

Explain the combustion characteristics of biogas.

- The combustion characteristics of biogas are-

(i) When produced in household-level biogas reactors, it is most suitable for cooking. Additionally electricity generation is a valuable option when the biogas is produced in large anaerobic digesters

(ii) Biogas has average methane content of 55-75% and CO_2 of 40% produced by anaerobic digestion of organic material.

(iii) This implies an energy content of 6-6.5 kWh/m^3. The thermal energy available from biogas is about 6 kWh/m^3.

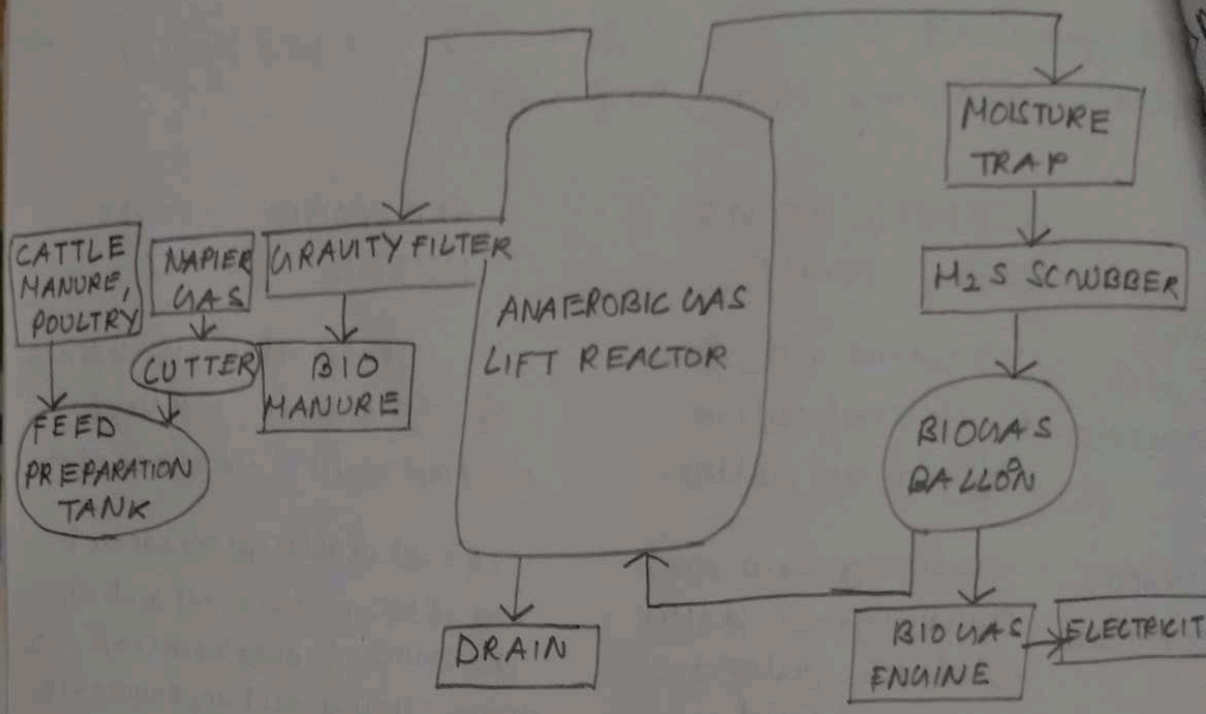
(iv) This corresponds to half a litre of diesel oil and 5.5 kg of firewood, 1 kg of faeces generates about 50 litres of biogas.

(v) The calorific efficiency of using biogas is 55% in stoves, 24% in engines, but only 3% in lamps.

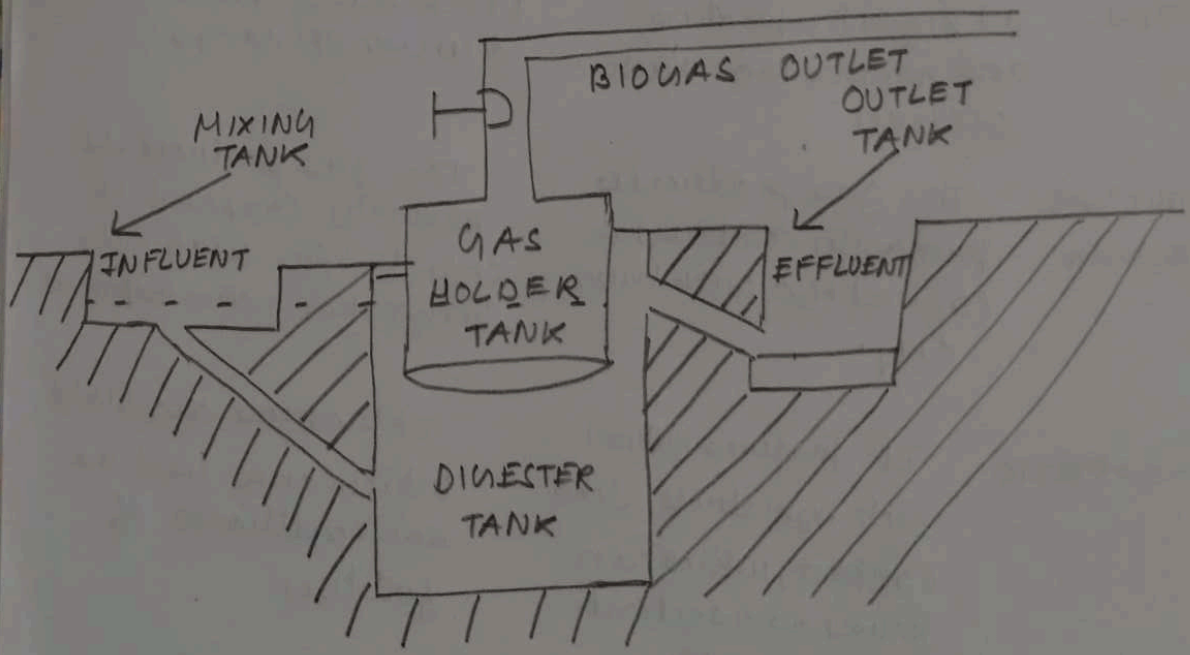
(vi) Biogas is usually fully saturated with water vapour which leads to condensation.

(vii) It leads to generation of 1 kWh of electricity with biogas/diesel mixture: 700 L/h, household burners: 200-450 L/h, refrigerators (100 L) depending on the outside temperature: 30-75 L/h, gas lamp equivalent to a 60 W bulb: 120-150 L/h, biogas/diesel engine per bhp: 420 L/h, plastic moulding press (150 g, 100 units) with biogas/diesel mixture: 40 L/h

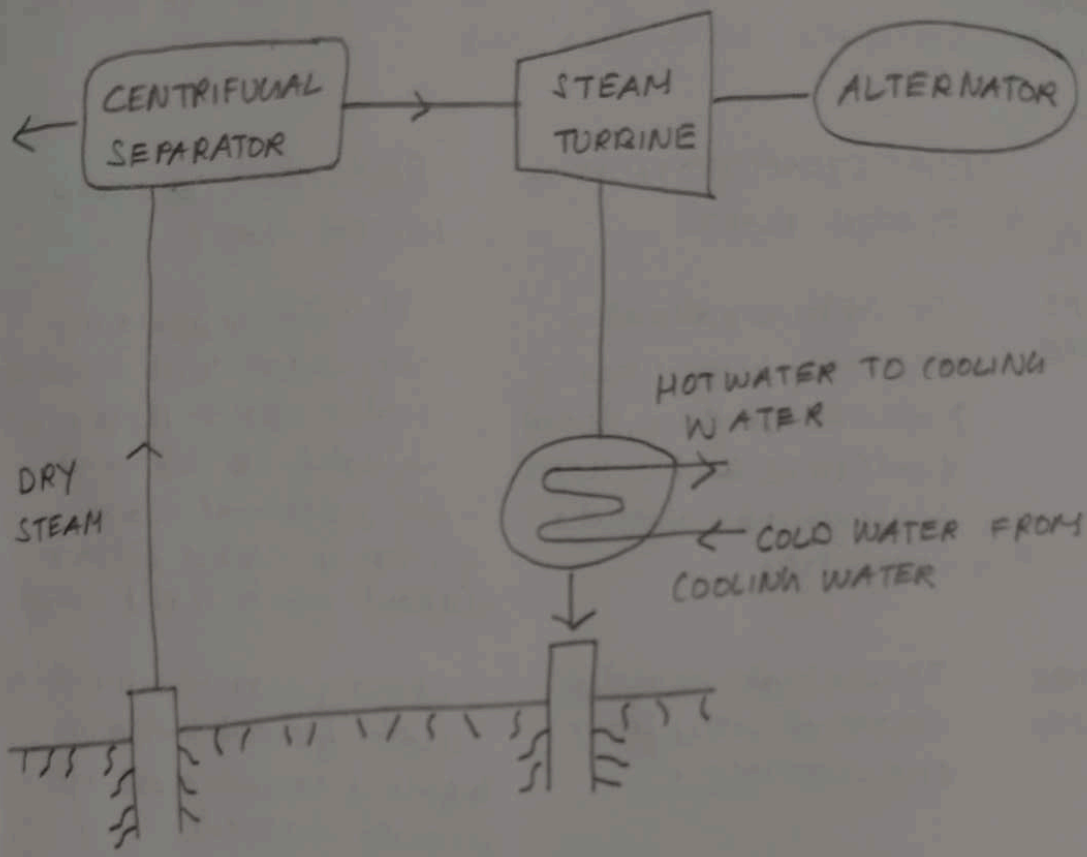
(viii) Gas demand can be defined on the basis of energy previously consumed.



ANAEROBIC BIOGAS POWER PLANT



AEROBIC BIOGAS POWER PLANT



DRY STEAM POWER PLANT

Differentiate the flash and dry steam geothermal power plants. Draw the schematics also.

Ans -

BASIS	FLAT STEAM GEOTHERMAL POWER PLANT	DRY STEAM GEOTHERMAL POWER PLANT
STEAM SOURCE	It contains naturally occuring high-pressure, high-temperature steam that can be used to turn turbines and generate electricity	It contains primarily dry steam with minimal water vapour. These are situated in regions where the geothermal resource primarily consist of steam without much liquid water.
RESOURCE QUALITY	It uses high-quality steam directly from the reservoir.	It may require separating water from the steam before it can be used to generate electricity.
CONVERSION PROCESS	steam from the reservoir is directly channeled to drive turbines.	The dry steam is typically separated from any liquid water present in the reservoir.
EFFICIENCY	They are highly efficient	They can be less efficient if the steam ~~starts~~ contains impurities.
LOCATIONS	These are often found in regions with easily accessible, high-quality geothermal steam reservoirs	They are located in areas with dry steam dominated geothermal resources.

(Q2) Explain any two applications of solar thermal energy.

Ans- Two applications of solar thermal energy are-

(i) ELECTRICITY GENERATION- • Concentrated solar power facilities are a kind of thermal power plant to generate electricity.

• These systems use solar thermal collectors to obtain heat.

• These plants use fuel to generate steam at a very high temperature

• They convert solar radiation into thermal energy, later into mechanical energy and finally into electrical energy

• The solar radiation is concentrated on a power tower where the thermal energy generates steam.

(ii) PRODUCTION OF DOMESTIC HOT WATER – • Flate plate collectors can be quickly heated on the roof and heat exchangers

• The time to heat a litre of water is longer than the time it takes to consume. Thus, we cannot heat at the same time it is needed. TO solve this we can use energy storage systems.

• In small house, it is pervasive to see solar collectors. The function of these solar panels is to heat sanitary hot water for domestic use or heating

Explain any two kinds of instrument used for the measurement of solar radiation.

Ans Solarimeter is an instrument used for measuring the flow of solar radiation. It uses the photovoltaic effect to measure the amount of solar radiation reaching a given surface. A Solarimeter using the photovoltaic effect has the same response as a photovoltaic system. It produces an electrical signal as a function of the incident light. It responds mostly to visible light and its output depends on the temperature of the cell. It captures light waves from approximately 330nm to 1100nm. To obtain a temperature independent readings, the values measured by a photovoltaic cell solarimeter must be corrected to compensate for temperature.

Pyranometers are instruments used to measure the global radiation on a surface. They work by measuring the difference between the temperature of a clear bright surface and a dark one. A dark surface can absorb most of the solar radiation while a clear surface tends to reflect it, absorbing less heat. This difference in temperature is measured using a thermopile and the difference of potential generated in the thermopile. The response of this type of pyranometer can over the entire range of wavelengths of the solar spectrum 300nm to 280nm. The spectral range detectable by a pyranometer is wider than that measurable within a Silicon cell solarimeter.