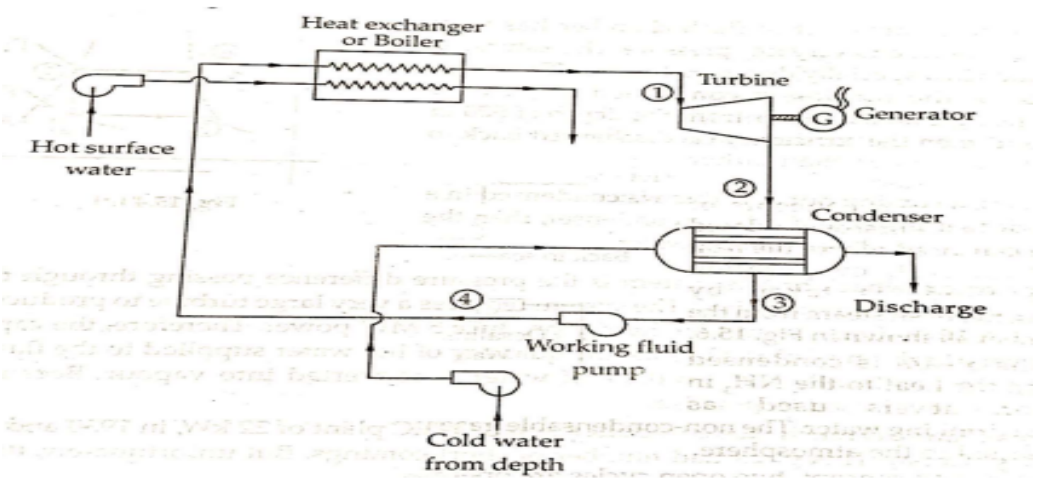
NCES 3rd ASSIGNMENT with ANS

1. **Explain with neat sketch closed cycle OTEC system.**

Rankine or Anderson cycle. In this system, the working fluid is separated from the heat transfer fluid (surface hot water and bottom cold water).The working fluid is generally some refrigerant which boils at lower temperature and higher pressure. High pressure refrigerant vapour is generated in the boiler using heat from surface hot water. The generated refrigerant vapour expands in turbine and generates the power. The low pressure refrigerant vapour coming out of turbine is condensed in the condenser using cold sea water. The condensed refrigerant coming out of condenser is further fed to the refrigerant boiler and the cycle is completed.

power developed by the turbine is say P kW,
amount of refrigerant in the cycle is given by $P = mr(h1 - h2)$
amount of hot water in refrigerant boiler is given by $mwhCpw(\Delta T)h = mr(h1 - h4)$
$(\Delta T)h$ is the drop in temperature of the hot water coming out of the refrigerant boiler.
amount of cold water from the depth in condenser is given by $mwhCpw(\Delta T)c = mr(h2 - h3)$
$(\Delta T)c$ is the increase in temperature of the cold water passing through the condenser.
efficiency of the cycle is given by $\eta c = h1 - h2 / h1 - h4 \Rightarrow h1 - h2/h1 - h3$
As h4 = h3, if the pump work is neglected.



2. **What are the advantages and disadvantages of OTEC?**

Advantages of OTEC system :

- Power from OTEC is continuous, renewable, and pollution-free.
- Unlike other forms of solar energy, the output of OTEC shows very little daily or seasonal variation.
- Drawing of warm and cold seawater and returning

- the seawater, close to the thermocline, could be accomplished with minimal environmental impact.

Disadvantages of an OTEC system

1. Capital investment is very high.
2. Conversion efficiency is very low about 3-4% due to the small temperature difference between the surface water and deep water
3. The low efficiency of these plants coupled with high capital cost and maintenance cost makes them uneconomical for small plants.

3. Explain with neat sketch the working of KVIC bio gas model.

The gas holder is a drum constructed of mild steel sheets. This is cylindrical in shape with concave top. The top is supported radially with angular iron stripes. The holder fits into the digester like a stopper. It sinks into the slurry due to its own weight and rests upon the ring constructed for this purpose. When gas is generated, the holder rises and floats freely on the surface of slurry. A central guide pipe is provided to prevent the holder from tilting. The holder also acts as a seal for the gas. The gas pressure varies between 7 and 9 cm of water column. Under shallow water table conditions, the adopted diameter of digester is more and depth is reduced. The cost of drum is about 40% of total cost of plant. It requires periodical maintenance. The unit cost of KVIC model with a capacity of 2 m3/day costs approximately Rs.14, 000/.

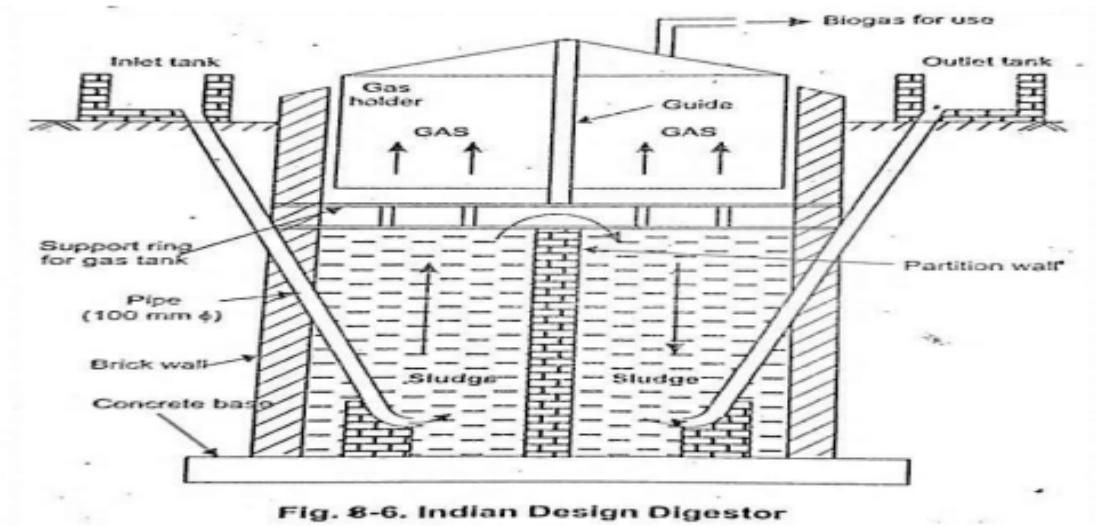


Fig. 8-6. Indian Design Digestor

4. What are the factors affecting biogas generation?

PH value: It is an index of hydrogen ion concentration in the mixture which also predicts acidity or alkalinity of the mixture. For effective gas generation the required PH value is 6.5 to 7.6. If this value decreases to 4-6, the mixture becomes acidic and if the value becomes 9-10 then it becomes alkaline. Both for acidic and alkaline conditions the methane forming

bacteria becomes inactive and the gas generation is reduced. Thus, for effective gas generation the required PH value is 6.5-7.5.

Temperature: The effect of temp on gas generation is as shown in graph. The two curves represent two types of bacteria which are sensitive to two different temp levels. Mesophilic type of bacteria will effectively generate gas at a temp of about 35o C. Thermophilic type of bacteria will generate gas effectively at a temp of about 55o C. As the temperature decreases or increases from the above values the period of gas generation will be increased. Since it is easy to maintain a temp of 35o C, it is advisable to select mesophilic type of bacteria for digestion.

Total solid content: The raw material added to the digester contains both solid and liquid in the ratio of 20:80 by weight. From the experience it is found that the gas generation is improved by maintaining the solid content of the mixture at about 8 to 10% by weight. This is done by adding water to the mixture.

Loading rate: It is the addition of the raw material to the digester/day/unit volume. The effective load rating is found to be 0.5 to 1.6 kg of solid material/day/m3

Seeding: During digestion the methane forming bacteria are consumed rapidly and their number will decrease affecting the gas generation. In order to maintain the quantity of methane forming bacteria, digested slurry from the previous batch is added to the digestor. The digested slurry is rich in methane forming bacteria and the process is known as seeding.

Uniform feeding: this is one of the prerequisites of good digestion. The digester must be fed at the same time every day with a balanced feed of the same quality and quantity.

Dia to depth ratio: from the experiments it is seen that the gas generation is improved by maintaining a dia to depth ratio of 0.66 to 1. This provides uniform temp distribution throughout the digester resulting in increased gas generation.

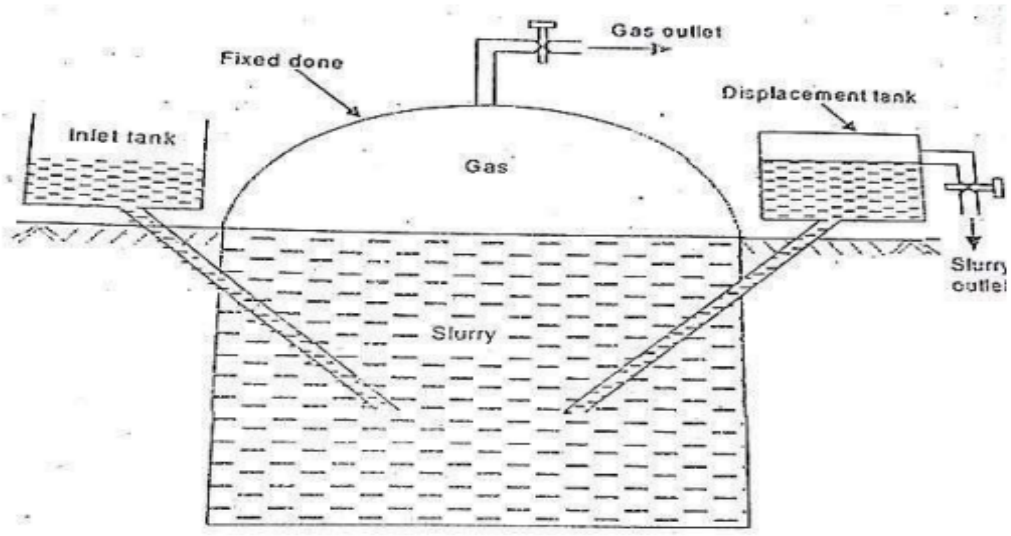
Carbon to nitrogen ratio: The bacteria in the digester utilize carbon for energy generation (as food) while nitrogen is used for cell building. Hence a carbon to nitrogen ratio of 30:1 is maintained for effective gas generation. If the ratio is not maintained the availability of carbon and nitrogen will vary resulting in reduced gas generation.

Nutrients: The nutrients required by the bacteria for food digestion are hydrogen, nitrogen, oxygen, carbon, phosphorous and sulphur. of this nitrogen and phosphorous have to be provided externally while the others are contained in the raw material itself. Nitrogen is provided by adding ‘leguminous plants’ (plants with seeds enclosed in casings, eg: Maize) which are rich in nitrogen content. Phosphorous is provided by adding ‘night soil’ (soil mixed with excreta of animals and humans) to the digester.

5. Explain with neat sketch the working of fixed dome (Chinese) biogas model.

The design of this plant is of Chinese origin but it has been introduced under the name Janata biogas plant” by Gobar Gas Research Station, Ajitmal in view of its reduced cost. This is a plant where no steel is used, there is no moving part in it and maintenance cost is low. The plant can be constructed by village mason taking some pre-explained precautions and using all the indigenously available building materials. Good quality of bricks and cement should

be used to avoid the afterward structural problems like cracking of the dome and leakage of gas. This model has a higher capacity when compared with KVIC model, hence it can be used as a community biogas plant. This design has longer life than KVIC models. Substrates other than cattle dung such as municipal waste and plant residues can also be used in janata type plants. The plant consists of an underground well sort of digester made of bricks and cement having a dome shaped roof which remains below the ground level is shown in figure. At almost middle of the digester, there are two rectangular openings facing each other and coming up to a little above the ground level, act as an inlet and outlet of the plant. Dome shaped roof is fitted with a pipe at its top which is the gas outlet of the plant. The principle of gas production is same as that of KVIC model. The biogas is collected in the restricted space of the fixed dome; hence the pressure of gas is much higher, which is around 90 cm of water column.



6. What is the problem associated with OTEC?

1. The marine life is very much affected.
2. Release of toxic chemicals and entrainment of small sea organisms in intake pipe is very common.
3. The atmosphere surrounding the OTEC system gets disturbed because of high water discharges (4 m3/MW).
4. The marine environment is affected because of change in salinity, dissolved gases and carbonates.
5. The large discharge of mixed water below the sea surface for a long time affects the production rate of fishes as pH value of mixed water also changes.
6. Toxic chemicals from the plant (say NH,) may leak to the environment and may kill the marine organisms.

7. **Write a short note on application of biogas.**

Biogas is a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen.

- It is used as a fuel for heating purpose like cooking
- It can also be used in production of electricity.
- Electricity generation
- In combined heat and power (CHP) plants
- Waste Management in agriculture
- Cooking fuel as a sustainable energy source
- Injection into a natural gas pipeline
- As a Clean Renewable Fuel for Transport Vehicles
- In Biogas Fuel Cells.

8. **Discuss the scope of geothermal energy in India.**

Geological Survey of India has found around 340 hot springs across India. India has 5 geothermal provinces and a number of geothermal springs. Geothermal resources in India have been mapped by GSI and broad estimate suggests that there could be 10 gigawatt (GW) geothermal power potential, as per the Ministry of New and Renewable Energy (MNRE). Under the proposed Geothermal Energy Policy, the Ministry of New and Renewable Energy of India (MNRE) has proposed to provide grants for geothermal energy project for generating power, industrial use, public use like greenhouse cultivation, space heating, cooking, etc., and Ground Source Heating Pumps (GSHPs).

The potential for harnessing geothermal energy in India is vast. The current documented uses or applications of geothermal energy in India have been for fisheries and crop drying. project in Gujarat was started by the Centre of Excellence for Geothermal Energy (CEGE). Similarly, other proposed areas have been subjected to more exploration in India. The proposed geothermal power plants in India are

- Puga Valley (Jammu and Kashmir)
- Tatapani in Chhattisgarh
- Godavari Basin Manikaran in Himachal Pradesh
- Bakreshwar in West Bengal
- Tuwa in Gujarat
- Unai and Jalgaon in Maharashtra
- Rajgir and Munger in Bihar and Jharkhand

9. Explain with neat sketch binary geothermal power cycle.

A binary cycle is a method for generating electrical power from geothermal resources and employs two separate fluid cycles, hence binary cycle. The primary cycle extracts the geothermal energy from the reservoir, and secondary cycle converts the heat into work to drive the generator and generate electricity. In the binary cycle, heat is transferred from the geothermal fluid to a secondary working fluid. During this heat transfer process, the pressurized working fluid is vaporized. The working fluid leaving the geothermal heat exchangers is subsequently expanded through a turbine producing work, or electrical power. A binary power plant has several advantages such as reservoir sustainability, high reliability operation, and environmental friendliness. In our study, we used Isopentane as the secondary working fluid.