

Unit 3:- Biomass Energy



Syllabus...Unit 3

- Energy from Biomass, Thermo-Chemical, Bio-Chemical Conversion to fuels. Bio-gas and its applications

Books ...

- Gilbert M. Masters, *Renewable and Efficient Electrical Power Systems*, Wiley - IEEE Press, August 2004.
- Godfrey Boyle, *Renewable Energy*, Third edition, Oxford University Press, 2012.
- Chetan Singh Solanki, *Solar Photovoltaics-Fundamentals, Technologies and Applications*, PHI Third Edition, 2015.

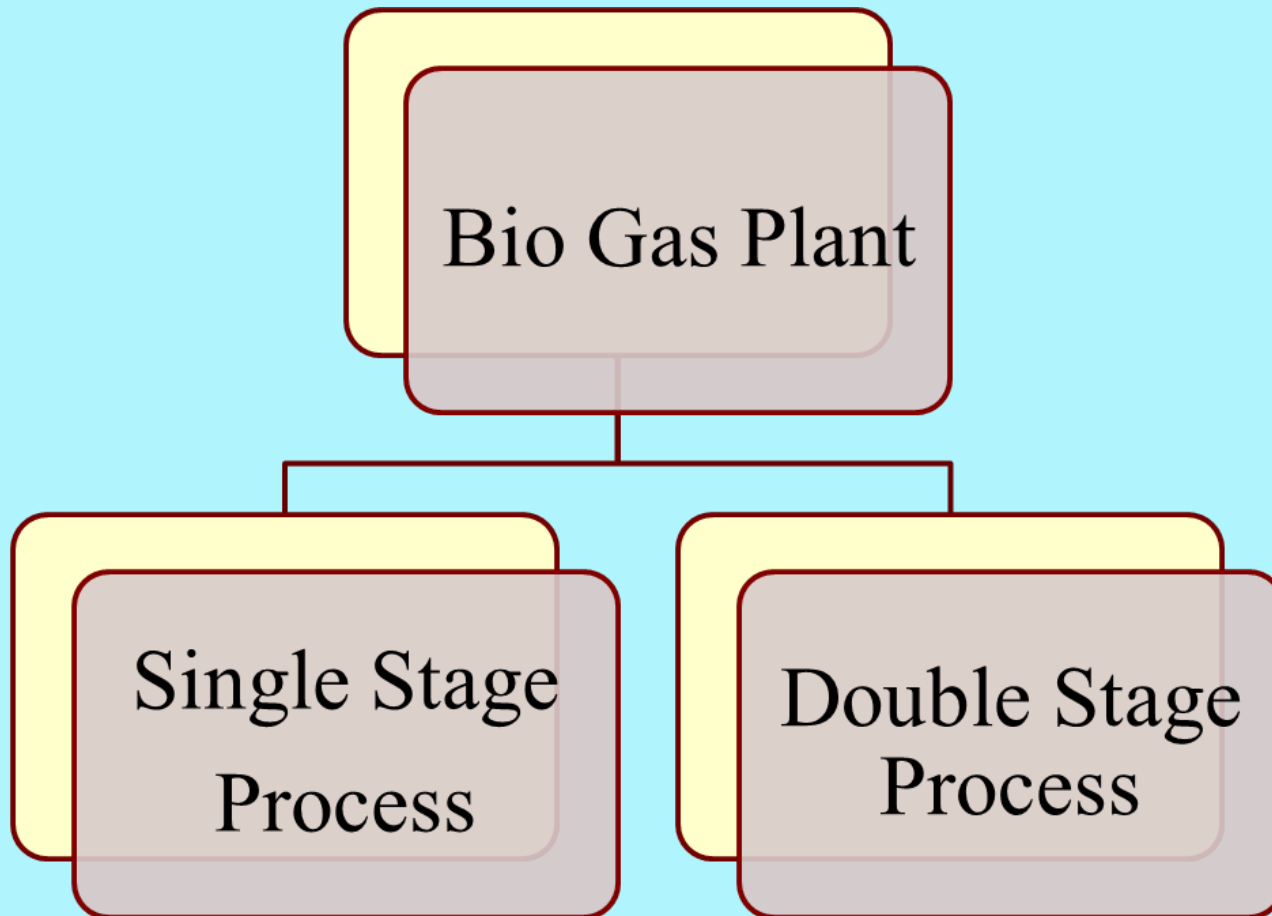
Supplementary Reading:

- D.P.Kothari, K.C.Singal, Rakesh Rajan, *Renewable Energy Sources and Emerging Technologies*, PHI Second Edition, 2011.

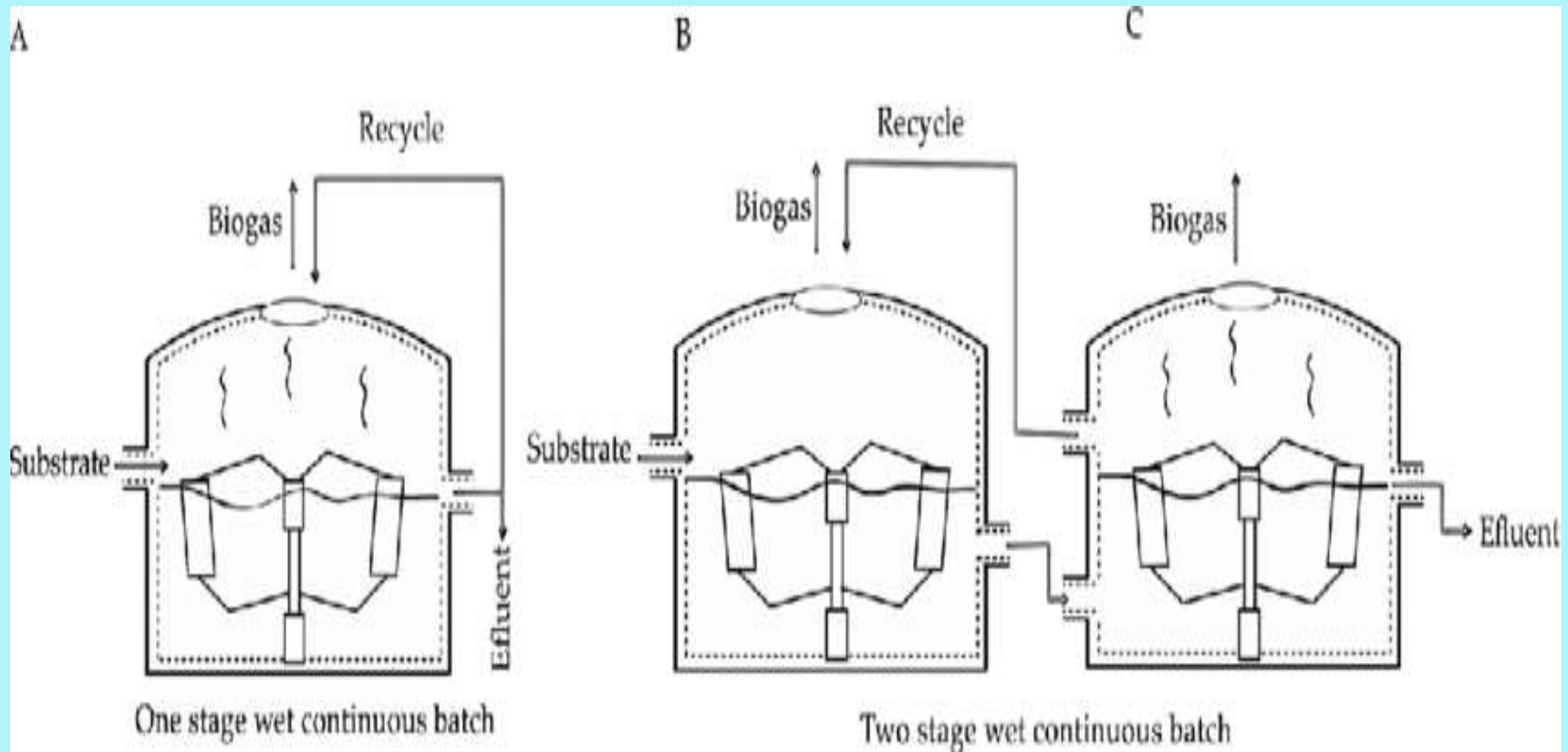
Lecture 5

- Bio-gas Classification
- Batched Type Plant
- Continuous Type Plant
- Single Stage Continuous Type Plant
- Two Stage Continuous Type Plant
- Features of Continuous Type Plant
- Features of Batched Type Plant
- Floating Gas Holder Plant
- Fixed Dome Type Plant
- Variations in Drum Type
- Advantages of biogas
- Disadvantages of biogas
- Applications of biogas

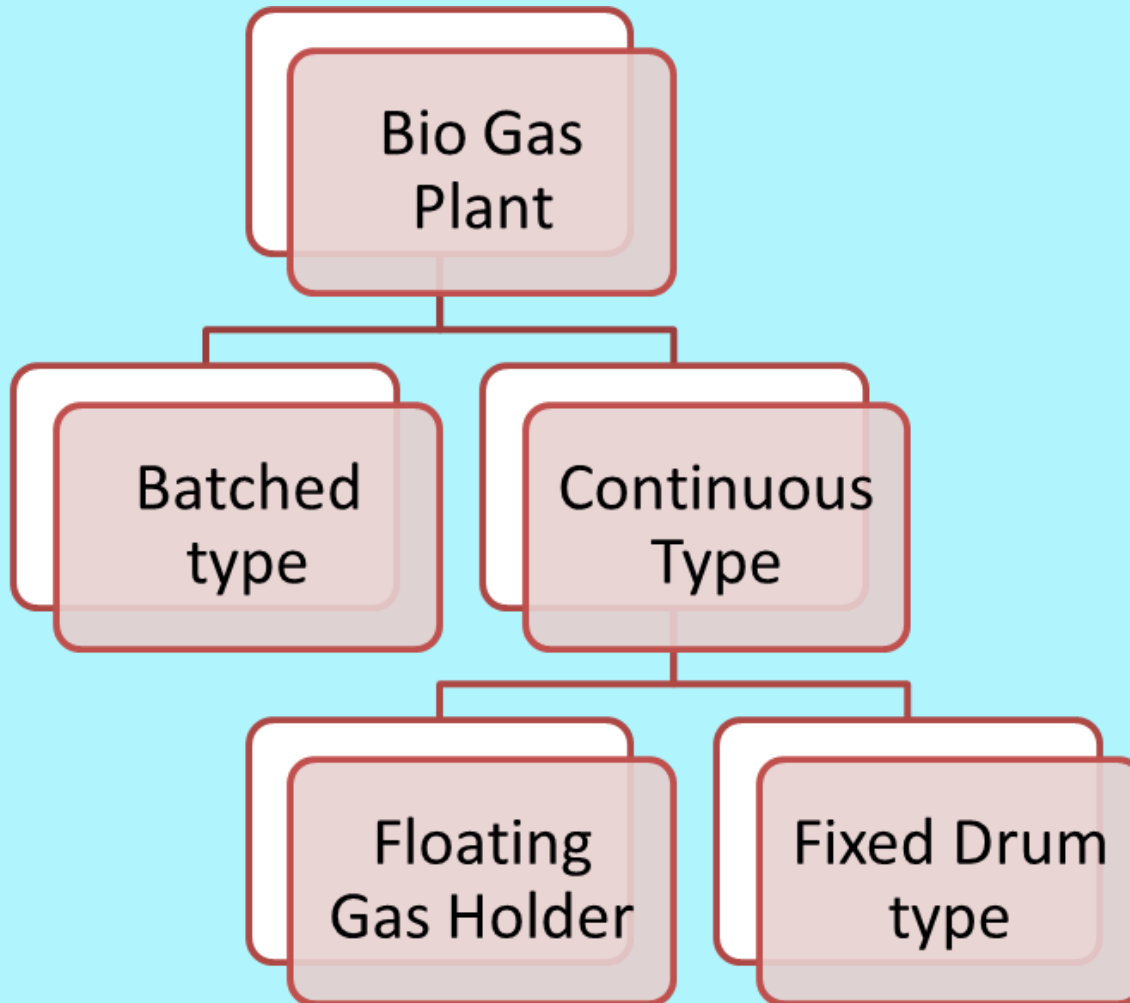
Biogas Plant Classification.....



Biogas Plant Classification.....



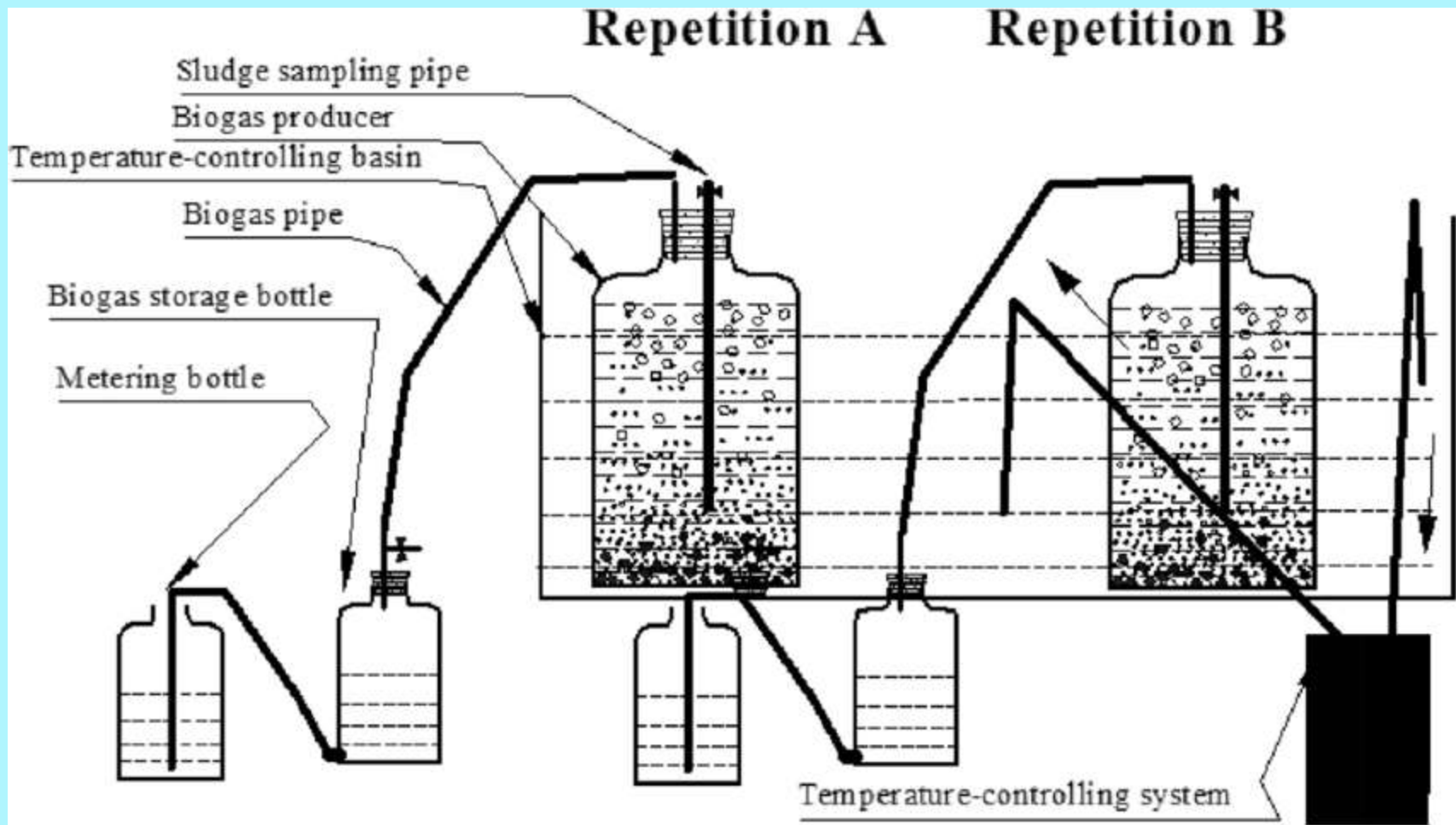
Biogas Plant Classification.....



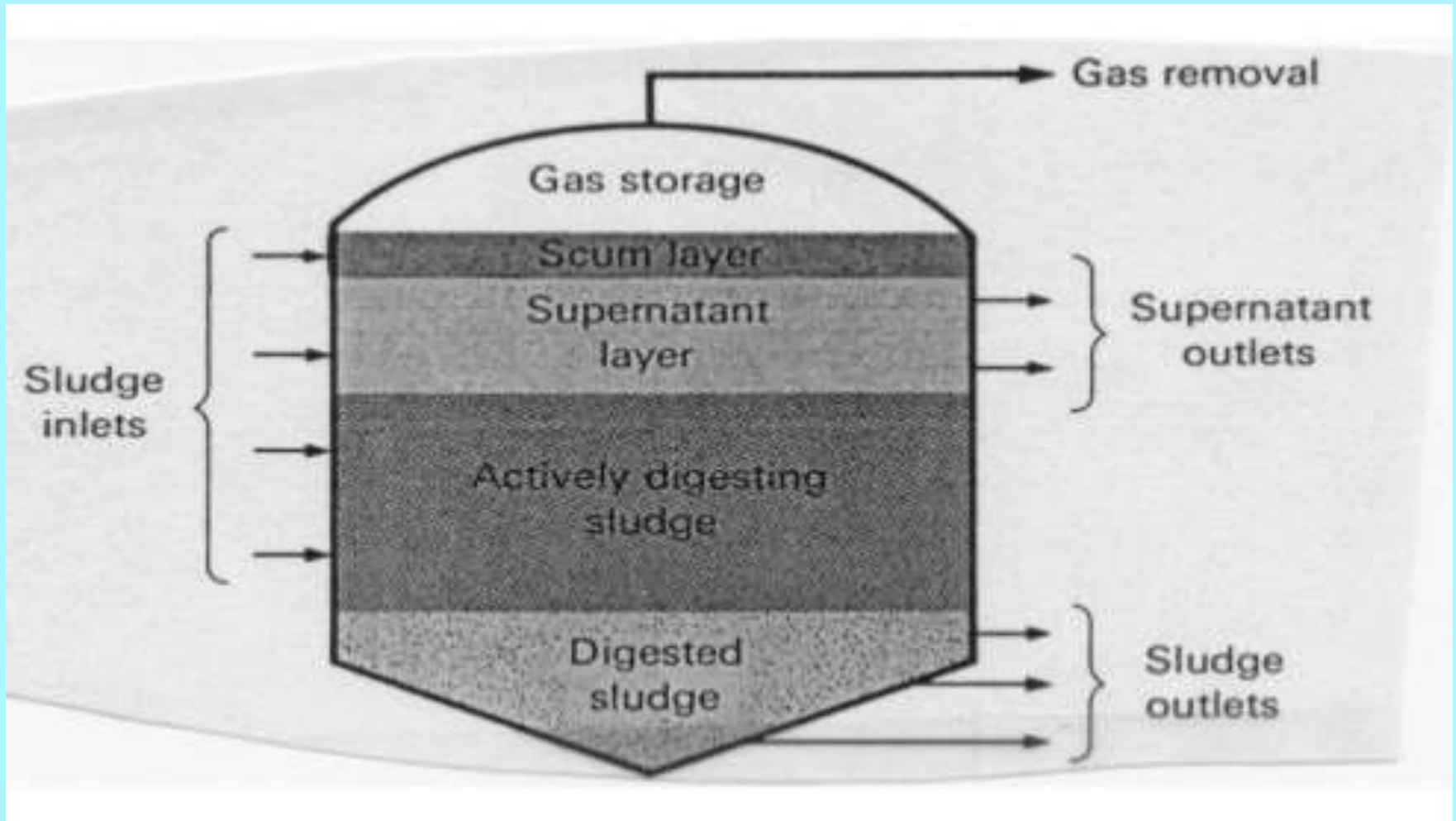
Batched Type Plant

- Batch type biogas plants are appropriate where daily supplies of raw waste materials are difficult to be obtained.
- A batch loaded digester is filled to capacity sealed and given sufficient retention time in the digester.
- After completion of the digestion, the residue is emptied and filled again.
- Gas production is uneven because bacterial digestion starts slowly, peaks and then tapers off with growing consumption of volatile solids.
- This difficulty can overcome by having multiple digesters so that at least one is always in operation.
- This problem can also minimize by connecting batch loaded digester in series and fed at different times so that adequate biogas is available for daily use.

Batched Type Plant



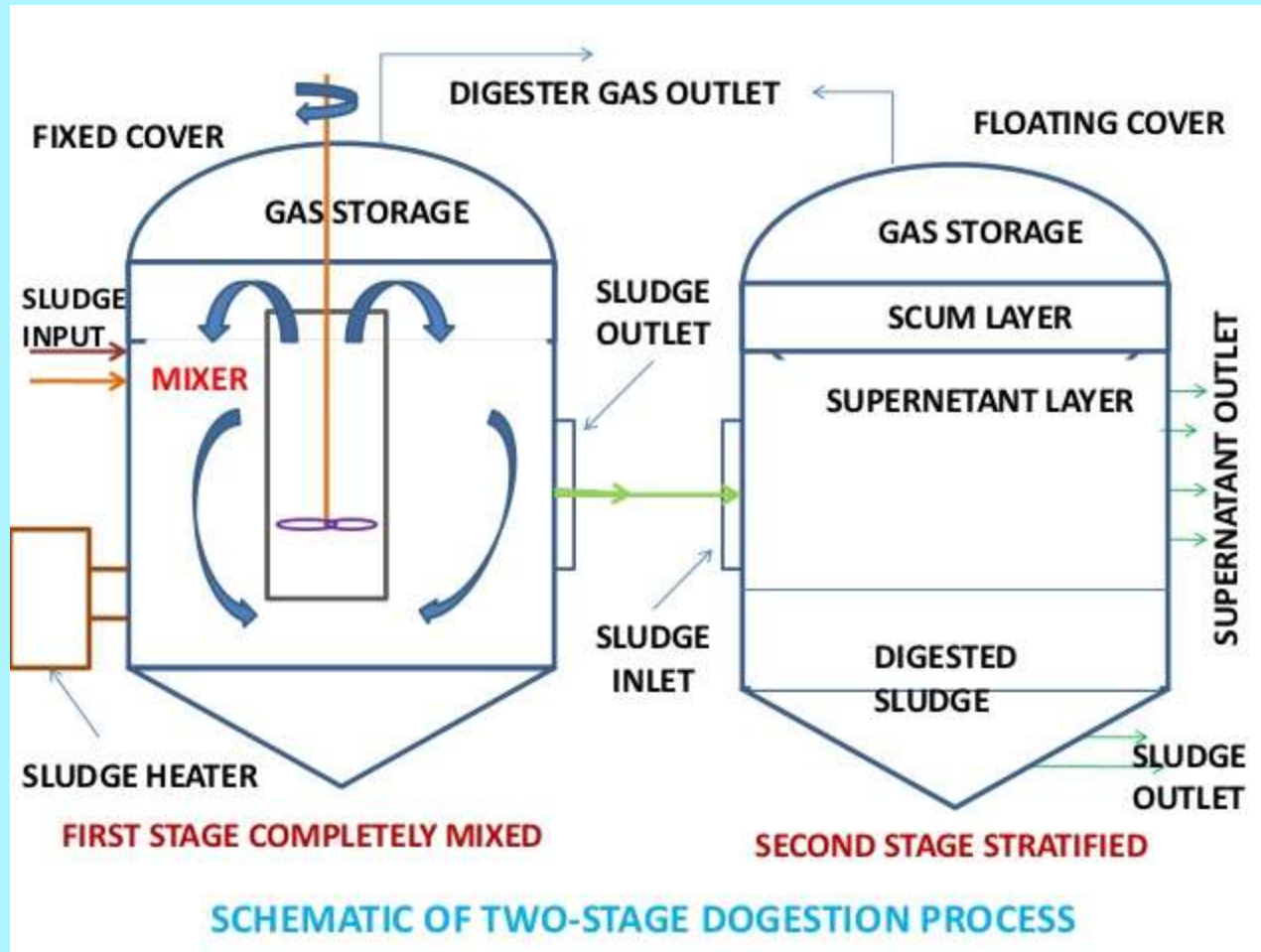
Single Stage Continuous Plant



Continuous Type Plant

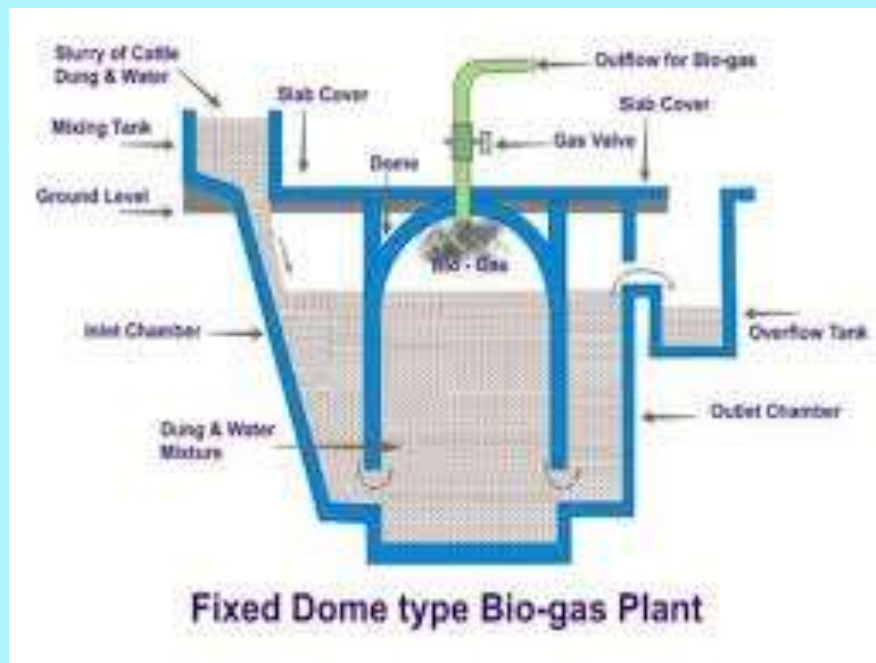
- In continuous type biogas plant, the supply of the gas is continuous and the digester is fed with biomass regularly.
- Continuous biogas plants may be single stage, double stage or multiple stage.
- Digestion of waste materials in a single chamber or digester is called single stage process, in two chambers or digesters is called multi stage process.
- In double stage process, acidogenic and methanogenic stage are physically separated into two chambers. Thus, the first stage of acid production is carried out in a separate chamber and only diluted acids are fed into the second chamber where biomethanation takes place.
- In single stage ,acidogenic and methanogenic stage are carried out in the same chamber without barrier.

Two Stage Continuous Plant



Features of Continuous Plant.....

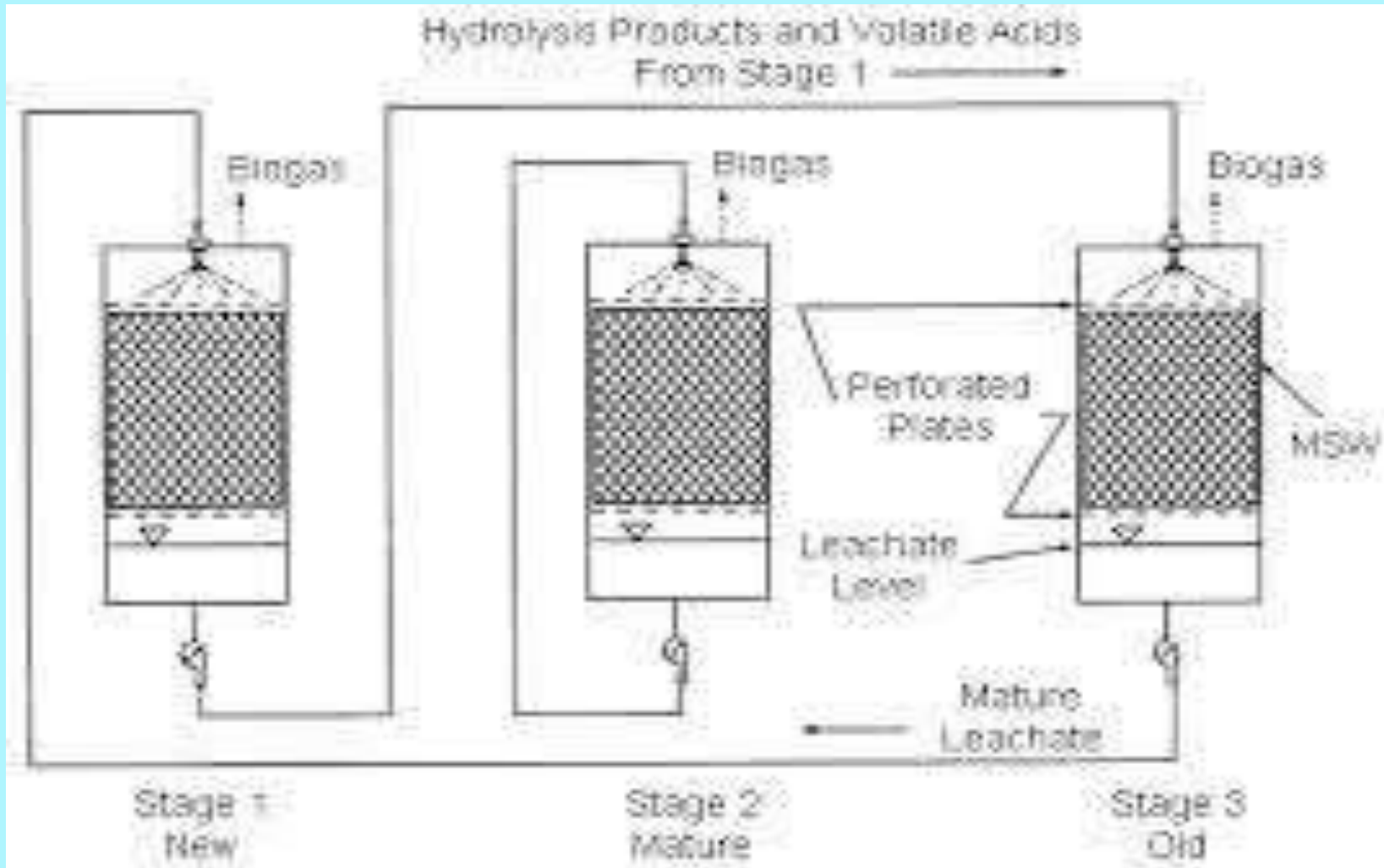
1. Plant will produce gas continuously
2. Plant requires small digestion chambers.
3. Plant needs smaller period of digestion.
4. It has less problem compared to batch type
5. It is easier in operation.



Features of Batch Plant.....

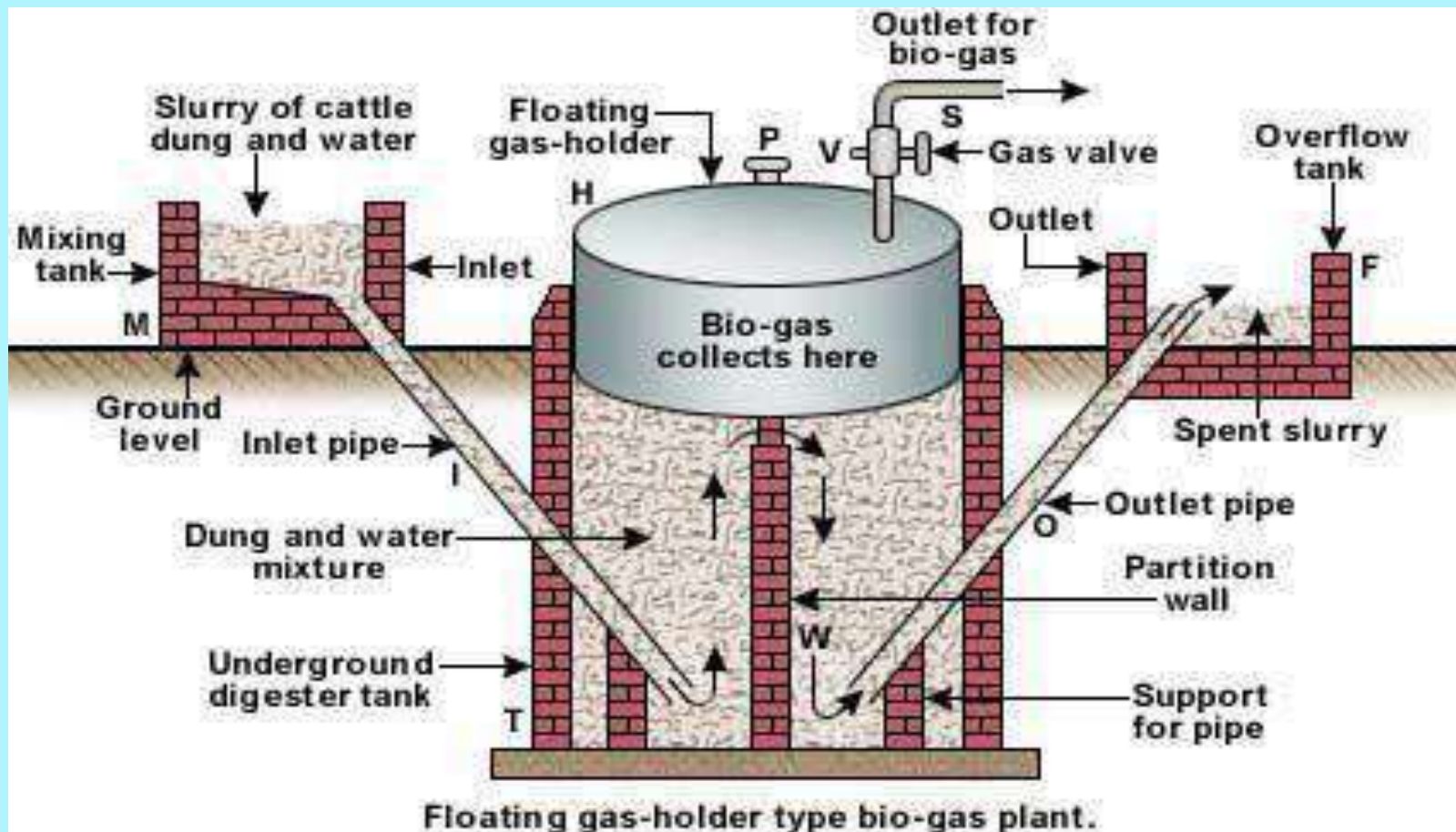
1. Gas production in batch type is uneven.
2. Batch type plants may have several digesters for continuous supply of gas.
3. It depends upon clearing of digester
4. Several digesters occupy more space.
5. Batch plants are good for long fibrous materials
6. This type of plants require large volume of digester, therefore, initial cost becomes high.
7. This plant needs addition of fermented slurry to start the digestion process.
8. The Plant is expensive and has comparatively more problems

Features of Batch Plant.....



Floating Gas Holder Plant.....

In a floating gas holder, gas holder is separated from the digester. Also known as KVIC plant



Floating Gas Holder Plant.....

Floating-drum Plants

1. Mixing tank with inlet pipe & Digester.
2. Overflow on outlet pipe.
3. Gasholder with braces for breaking up surface scum.
4. Gas outlet with main cock.
5. Gas drum guide structure.
6. Difference in level = gas pressure in cm WC.
7. Accumulation of thick sludge.

Floating-drum plants (Figure) consist of a digester and a moving gasholder. The gasholder floats either direct on the fermentation slurry or in a water jacket of its own. The gas collects in the gas drum, which thereby rises. If gas is drawn off, it falls again. The gas drum is prevented from tilting by a guide frame.

Floating Gas Holder Plant.....

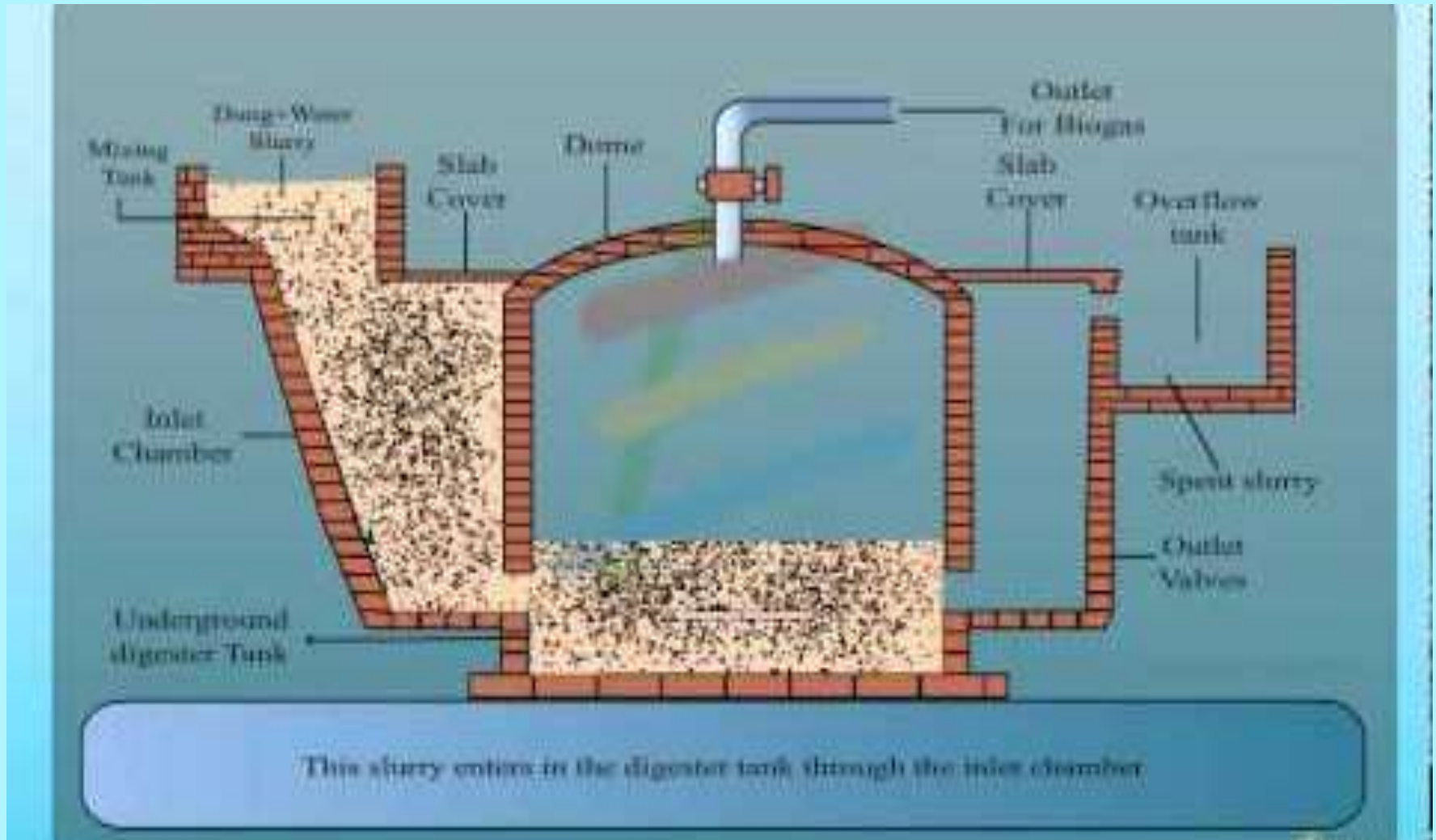
Advantages: Simple, easily understood operation, constant gas pressure, volume of stored gas visible directly, few mistakes in construction.

Disadvantages: High construction cost of floating-drum, many steel parts liable to corrosion, resulting in short life.

In spite of these disadvantages, floating-drum plants are always to be recommended. Water-jacket plants are universally applicable and especially easy to maintain. The drum won't stick, even if the substrate has a high solids content.

Works up to 15 years; in tropical coastal regions about five years for the drum, needs regular maintenance costs

Fixed Dome Type Plant.....



Fixed Dome Type Plant.....

In fixed dome digester, the gas holder and the digester are combined. **Also known as Chinese Plant**

The fixed dome is best suited for batch process especially when daily feeding is adopted in small quantities. The plant is generally built below the ground level and is suitable for cooler regions.

Advantages of Fixed-dome plants

Low construction cost, no moving parts, no rusting steel parts, hence long life (20 years or more), underground construction, affording protection from winter cold and saving space,

Disadvantages: Plants often not gastight (porosity and cracks), gas pressure fluctuates substantially and is often very high, low digester temperatures.

These plants can be recommended only where construction can be supervised by experienced biogas technicians

Variations in Drum Type ...

- There are mainly two variation in floating type plant. One with *water seal* and other *without water seal*.
- Water sealing makes the plant completely anaerobic.
- Cylindrical shape of the digester is preferred because cylinder has no corners and so that there will be no chances of cracks due to faulty construction. This shape also needs smaller surface area per unit volume, which reduces heat losses also.
- Moreover the scum formation may be reduced by rotating gas holder in the cylindrical digester.

Advantages of biogas...

- Cost of equipment's used for making biogas is low and equipment's used are very simple.
- Biogas can be used for lighting, running the engines, farm's machine and cooking gas in the kitchen.
- Biogas is the best medium for cooking food.
- Organic feed stocks used in the plants are easily available at all places.
- Biogas plant gives efficiency as much as 60%.
- Distribution of gas has no problems of any gas leakage and fire.
- Waste product obtained from digester is best quality of fertilizer and gives best yields.

Disadvantages of biogas...

- Biogas produced from biogas plant has to be used at near by places only.
- It can't be transported over long distances.
- Biogas can't be filled in the bottles.
- Biogas plant requires more area.
- It can't be established in urban area where availability of land is limited.

Applications of biogas...

- Biogas is used as cooking fuel.
- Biogas is mental light gas burner for lighting purpose.
- Biogas is used for water heating.
- It is used as fuel in I.C. Engine.
- It is used as fuel to run agricultural machineries.
- It is used to run diesel engine generator set to produce electricity.
- Heat of biogas is utilized in the dryer for drying the agricultural products.
- Heat of biogas is used to heat ammonia of refrigerating plant.
- It is used for running pumps for irrigation purpose.
- Methane and carbon dioxide are used as raw chemical feed stock to manufacture various chemicals.

Thank You