Introduction

Biogas is a mixture of carbon dioxide and methane gas produced by the fermentation of organic waste. Biogas is colorless, flammable gas with a mixture of about 55 – 70 percent methane, 30 – 45 percent carbon dioxide, less than 1 percent hydrogen sulfide and a small amount of nitrogen, carbon monoxide, and oxygen. Such could be used as fuel for lighting, for cooking, and to power machine in the conversion of mechanical to electrical energy. Biogas is widely used in China in the early 20th century and was adapted worldwide contemporarily considering that the cost of exhaustible petroleum fuel is skyrocketing.

Biogas could be produced in the farm by the establishment of a biogas digester. It operates in anaerobic means with the use of farm waste such as manure, waste water, crop residues, and other organic garbage as main ingredients. The gas produced in this process can then be utilized to power the energy needed in the farm such as lighting, cooking, power generators, water pumps and many others. The effluent or solid waste matter can then be used as organic fertilizer or ingredient for the processing of compost. The water in the effluent can also be used as liquid fertilizer or may be recycled for farm use. Working in this principle not only mitigates farm inputs but also preserves the environment which is necessary to make the farm operation sustainable.

Advantages of Biogas Production

1. Sanitation in the farm is maintained because manure and other bio-degradable organic matter are kept on biogas digester.
2. Air, water, and ground pollution can be mitigated or controlled.
3. Production of organic fertilizer both in liquid and in solid form.
4. Sludge can be used as ingredient for livestock feeds.
5. Can incur savings on farm inputs such as electricity and fertilizer
6. Environmental conservation on air, water, and soil and flora and fauna.
7. Generation of employment.

Disadvantages of Biogas Production

1. High project cost
2. Requires at least 4 to 6 sows for significant home utilization of biogas.
3. Need care and maintenance
4. Requires water which is more often not available.

Components of Biogas System

I. Biogas Digester

Biogas digester is a structure where organic materials such as manure and other biodegradable farm waste are being processed for the production of methane gas. It is an anaerobic process wherein anaerobic bacteria naturally grow, multiply, and digest organic materials and eventually produce methane gas. Such process also breaks down organic materials into a form that is ready and available for use as fertilizer. However, empirical evidence suggest that nutrients such as protein, carbohydrates, and other minerals are not destroyed in the process thereby effluent emitted in the digester could also be utilized for other purposes such as feed ingredient and composting materials. Additional evidence further suggests that the liquid in the effluent carries with it no harmful microorganisms that could cause major disease if recycled for farm use for the reason that these microbes are destroyed in the process of digestion. This principle however caused skepticism among farmers who wished to lessen the cost of water usage for farm use. In such case, further studies are being undertaken in the local level in this perspective but international researches imply that the theory is right and what is needed is the whole-souled adaptation in our farming system.

Classification and Design Principles of Biogas Digester

Gas plants can be classified in 3 ways:

1. Plant set up

1.1 Integrated set-up

Digester and gas holder form one unit, suited for small biogas plants producing 500 cubic feet of gas per day.

1.1.1 Vertical design

Deep cylindrical of octagonal one chamber digester best suited in area where water level is low or cost of digging the ground is cheap.

1.1.2 Horizontal design

Shallow rectangular, 2-chamber digeser suited in areas where water level is high and cost of digging the ground.

2. Charging of the digester

2.1 Batch-fed digester - is best suited for larger plants using crop wastes together with manure as raw materials. It is charged with the fresh slurry and starter to full capacity and allowed to decompose up to full length of desired retention time, after which sludge is discharged.

2.2 Continuous-fed – digester is charged with small amount of fresh slurry every day and its sludge of approximately the same amount is expelled.

3. Arrangement used for collection of gas

3.1 Combined digester/gasholder

3.1.1 Fixed dome (Chinese design)

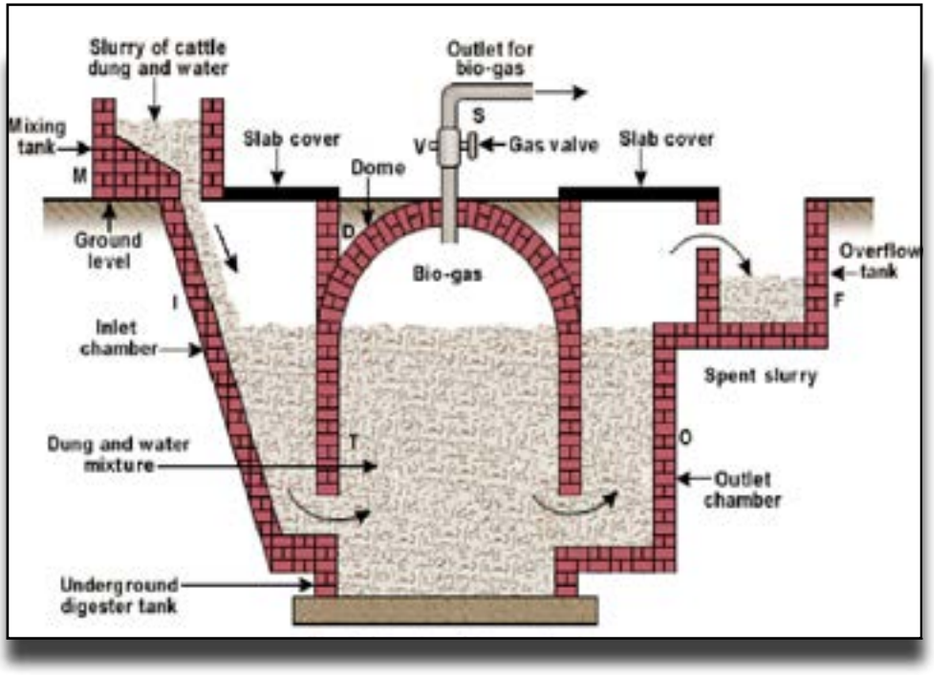
Usually operated on a batch basis but with daily small addition of manure, plant waste may be added. The cost is less because no steel sheets are required since floating gas holder is eliminated.

This is built below ground level hence less earth surface is being used.

3.1.2 Bag digester

Flexible bag that holds both gas and slurry.

Illustration 1. Sample design of fixed-dome type gas plant



3.2 Floating gas holder

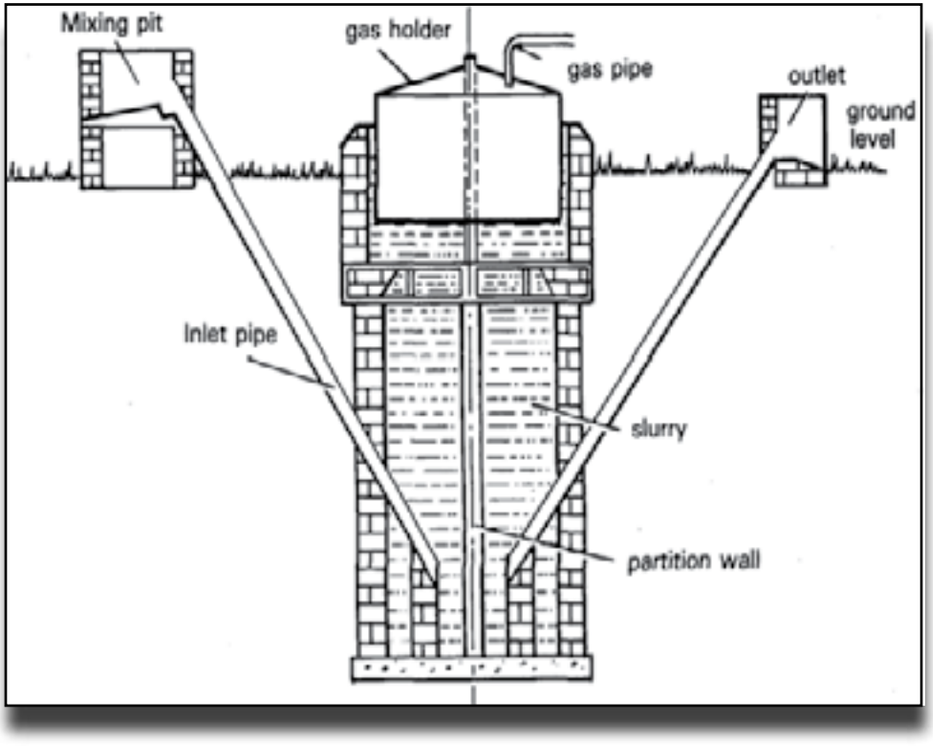
3.2.1 Indian design

Operates without water seal and is run on continuous basis as it has constant gas pressure, and is less expensive because the cost of water seal is eliminated. Gas holder can be lifted to facilitate cleaning of the digester. However, this type looks messy because the slurry sticks to the gas holder as it moves up and down. Further more, biogas is lost and a little foul odor may be detected near the plant, because of the exposed slurry surface of the digester.

3.2.2 Taiwan design

With water seal, it is very clean because gas holder dips in water and no slurry is exposed. This is more expensive because of the double walling for the water seal. Maintaining the water level is an additional operation and it is difficult to repair in case leaks develop.

Illustration 2. Sample design of Biogas Digester with floating gas holder



II. Gas holder

Gas holder is a container wherein the trapped biogas is stored for its eventual use. It can be made of steel, plastic, rubber, or concrete. It should be noted that biogas is corrosive and the use of steel requires more maintenance compared to plastic, rubber, and concrete.

III. Inlet Tank

Inlet tank is where the manure and waste water mixture is stored. It is a tank that collects the liquid and solid waste from the farm that is eventually drained to the digester on a desired time.

IV. Outlet Tank

The amount of liquid-solid mixture drained from the inlet tank is also the same amount of liquid-solid that is collected from the outlet tank. However, the aggregate is in digested form and is ready for use as fertilizer and biogas has already been extracted.

*Biogas digester without the gas holder showing the **inlet tank** (right box) and the **outlet tank** (left box).*

*Biogas digester installed with **biogas holder**.*

V. Accessories

a. Stirrer – A device used for stirring the scum on the slurry surface. For circular gas holders, stirring rods are attached inside which reach to the bottom of the digester. For square gas holder, a separate mixing device is fitted at the top of a frame is attached to the gas holder and this mixes the slurry as it moves up an down with the gas holder.

b. Condensate drain or water trap – A device that traps water that condenses along gas lines to allow the free flow of gas along the lines.

c. Gas pipes or gas lines – Gas lines that carries gas from the gas holder to the kitchen or lamp. It may be made of rubber hose plastic or steel.

d. Manometer – A pressure gauge that measures pressure on a gas holder.