Working of Biogas Plants

Biogas is a clean and efficient fuel. It is a mixture of methane (CH$_4$), carbon dioxide (CO$_2$), hydrogen (H$_2$) and hydrogen sulphide (H$_2$S).

The chief constituent of biogas is methane (65%).

Production of Biogas - The biogas plants

There are two types of biogas plants in usage for the production of biogas. These are:

- The fixed-dome type of biogas plant
- The floating gas holder type of biogas plant

Fixed dome type of biogas plant

Raw materials required

Forms of biomass listed below may be used along with water.

- Animal dung
- Poultry wastes
- Plant wastes (Husk, grass, weeds etc.)
- Human excreta
- Industrial wastes (Saw dust, wastes from food processing industries)
- Domestic wastes (Vegetable peels, waste food materials)

Principle

Biogas is produced as a result of anaerobic fermentation of biomass in the presence of water.

Construction

The biogas plant is a brick and cement structure having the following five sections:

- Mixing tank present above the ground level.
- Inlet chamber: The mixing tank opens underground into a sloping inlet chamber.
- **Digester**: The inlet chamber opens from below into the digester which is a huge tank with a dome like ceiling. The ceiling of the digester has an outlet with a valve for the supply of biogas.

- **Outlet chamber**: The digester opens from below into an outlet chamber.

- **Overflow tank**: The outlet chamber opens from the top into a small overflow tank.

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**Fixed Dome type Biogas Plant**

**Working**

- The various forms of biomass are mixed with an equal quantity of water in the mixing tank. This forms the slurry.

- The slurry is fed into the digester through the inlet chamber.

- When the digester is partially filled with the slurry, the introduction of slurry is stopped and the plant is left unused for about two months.

- During these two months, anaerobic bacteria present in the slurry decomposes or ferments the biomass in the presence of water.

- As a result of anaerobic fermentation, biogas is formed, which starts collecting in the dome of the digester.

- As more and more biogas starts collecting, the pressure exerted by the biogas forces the spent slurry into the outlet chamber.

- From the outlet chamber, the spent slurry overflows into the overflow tank.

- The spent slurry is manually removed from the overflow tank and used as manure for plants.

- The gas valve connected to a system of pipelines is opened when a supply of biogas is required.
To obtain a continuous supply of biogas, a functioning plant can be fed continuously with the prepared slurry.

**Advantages of fixed dome type of biogas plant**

- Requires only locally and easily available materials for construction.
- Inexpensive.
- Easy to construct.

**Floating gas holder type of biogas plant**

**Construction of the floating gas holder type plant**

The floating gas holder type of biogas plant has the following chambers/sections:

- **Mixing Tank** - present above the ground level.
- **Digester tank** - Deep underground well-like structure. It is divided into two chambers by a partition wall in between.

It has two long cement pipes:

i) Inlet pipe opening into the inlet chamber for introduction of slurry.

ii) Outlet pipe opening into the overflow tank for removal of spent slurry.

- **Gas holder** - an inverted steel drum resting above the digester. The drum can move up and down i.e., float over the digester. The gas holder has an outlet at the top which could be connected to gas stoves.
- **Over flow tank** - Present above the ground level.
Floating Dome type Biogas Plant

**Working**

- Slurry (mixture of equal quantities of biomass and water) is prepared in the mixing tank.
- The prepared slurry is fed into the inlet chamber of the digester through the inlet pipe.
- The plant is left unused for about two months and introduction of more slurry is stopped.
- During this period, anaerobic fermentation of biomass takes place in the presence of water and produces biogas in the digester.
- Biogas being lighter rises up and starts collecting in the gas holder. The gas holder now starts moving up.
- The gas holder cannot rise up beyond a certain level. As more and more gas starts collecting, more pressure begins to be exerted on the slurry.
- The spent slurry is now forced into the outlet chamber from the top of the inlet chamber.
- When the outlet chamber gets filled with the spent slurry, the excess is forced out through the outlet pipe into the overflow tank. This is later used as manure for plants.
- The gas valve of the gas outlet is opened to get a supply of biogas.
- Once the production of biogas begins, a continuous supply of gas can be ensured by regular removal of spent slurry and introduction of fresh slurry.

**Disadvantages of floating gas holder type biogas plant**

- Expensive
• Steel drum may rust
• Requires regular maintenance

Advantages of biogas as a fuel

• High calorific value
• Clean fuel
• No residue produced
• No smoke produced
• Non polluting
• Economical
• Can be supplied through pipe lines
• Burns readily - has a convenient ignition temperature

Uses of biogas

• Domestic fuel
• For street lighting
• Generation of electricity

Advantages of biogas plants

• Reduces burden on forests and fossil fuels
• Produces a clean fuel - helps in controlling air pollution
• Provides nutrient rich (N & P) manure for plants
• Controls water pollution by decomposing sewage, animal dung and human excreta.

Limitations of biogas plants

• Initial cost of installation of the plant is high.
• Number of cattle owned by an average family of farmers is inadequate to feed a biogas plant.