Types of floating gas holder type biogas plants

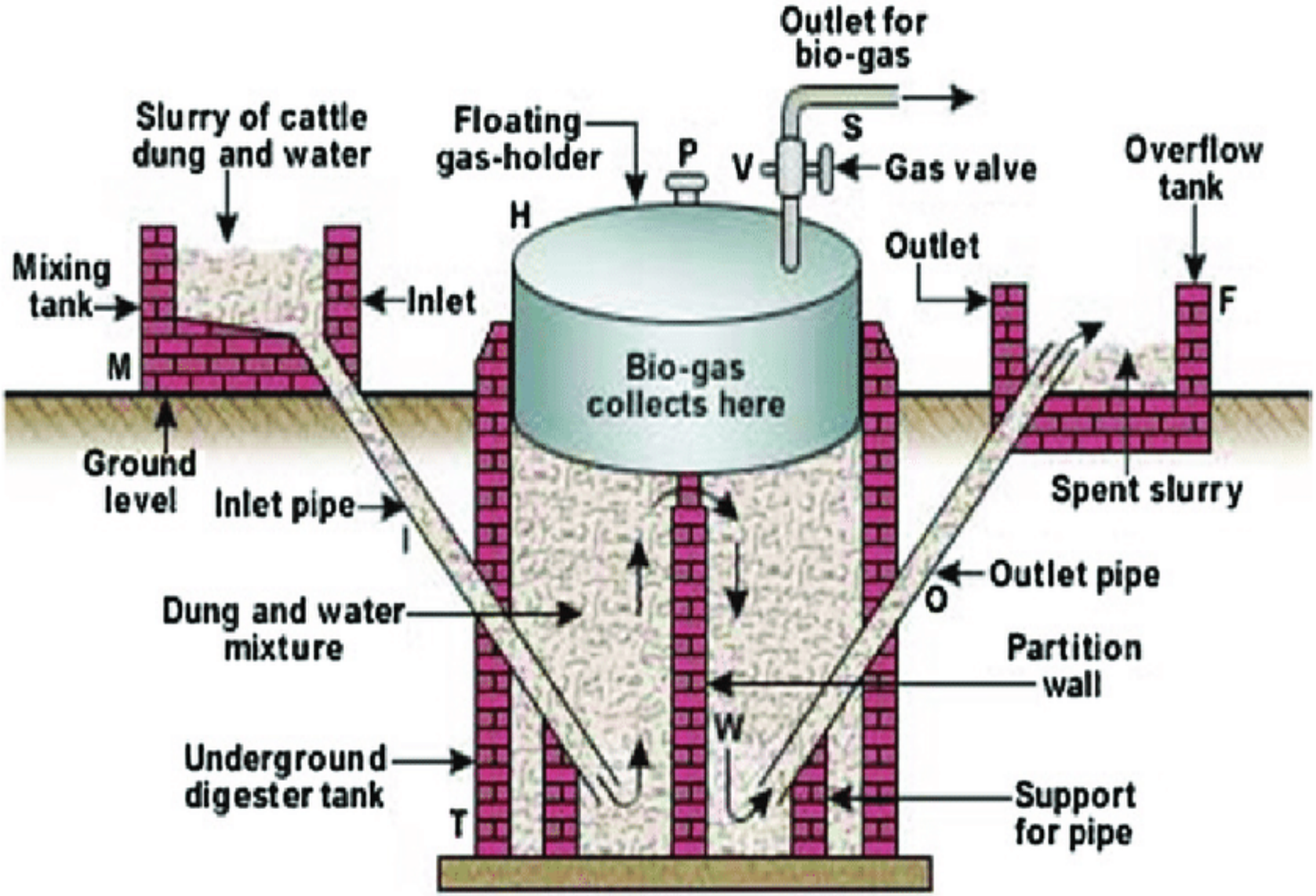
a) KVIC model with a cylindrical digester.
b) Pragati model with a hemisphere digester.
c) Ganesh model made of angular steel and plastic foil.
d) Floating drum plant made of pre-fabricated reinforced concrete compound units.
e) Floating drum plant made of fiber glass reinforced polyester.

In 1956, Jashu Bhai J Patel from India designed the first floating drum biogas plant, popularly called Gobar gas plant.

KVIC biogas plant

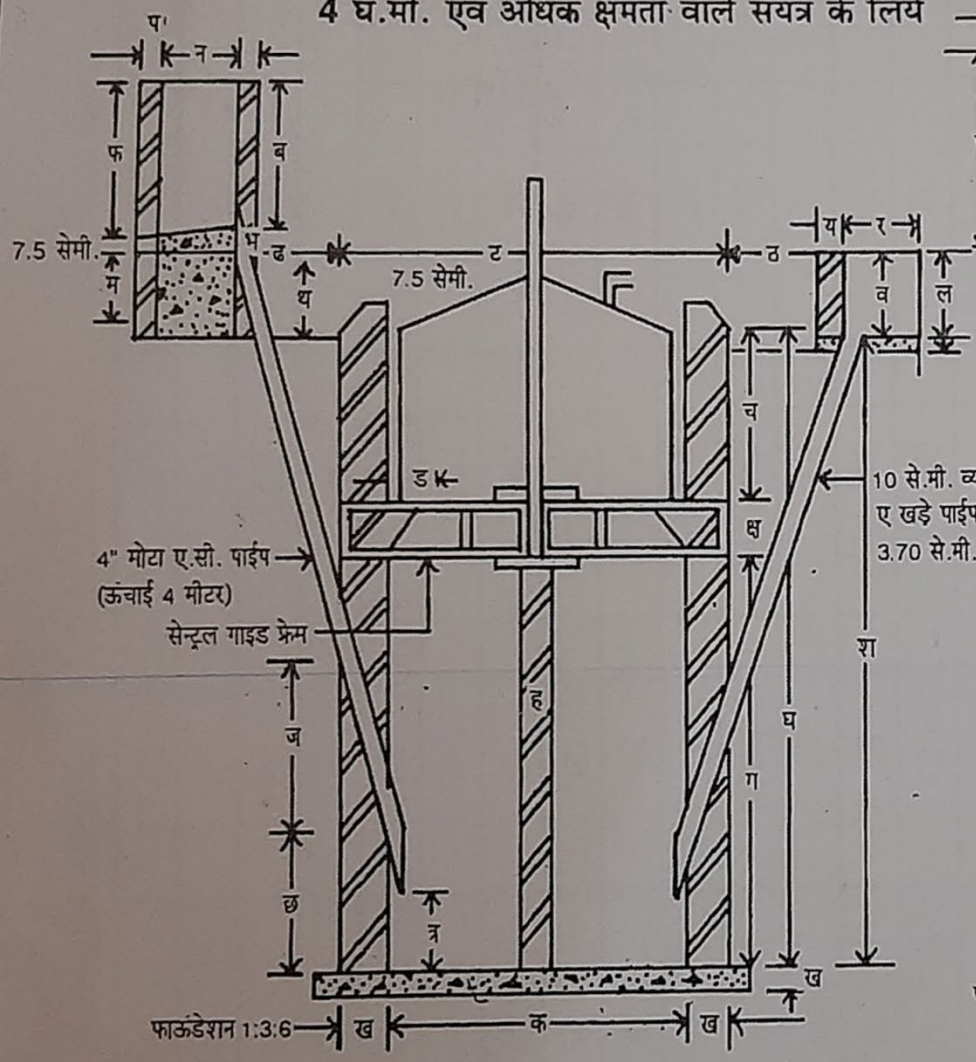
In the year1961 Khadi and Village Industries Commission (KVIC) patented this design.

KVIC MODEL


Outlet for bio-gas
Slurry of cattle dung and water
Floating gas-holder
P
V
S
Gas valve
Overflow tank
H
Outlet
Mixing tank
Inlet
F
M
Bio-gas collects here
Ground level
Inlet pipe
I
Spent slurry
Outlet pipe
O
Dung and water mixture
Partition wall
W
Underground digester tank
Support for pipe
T

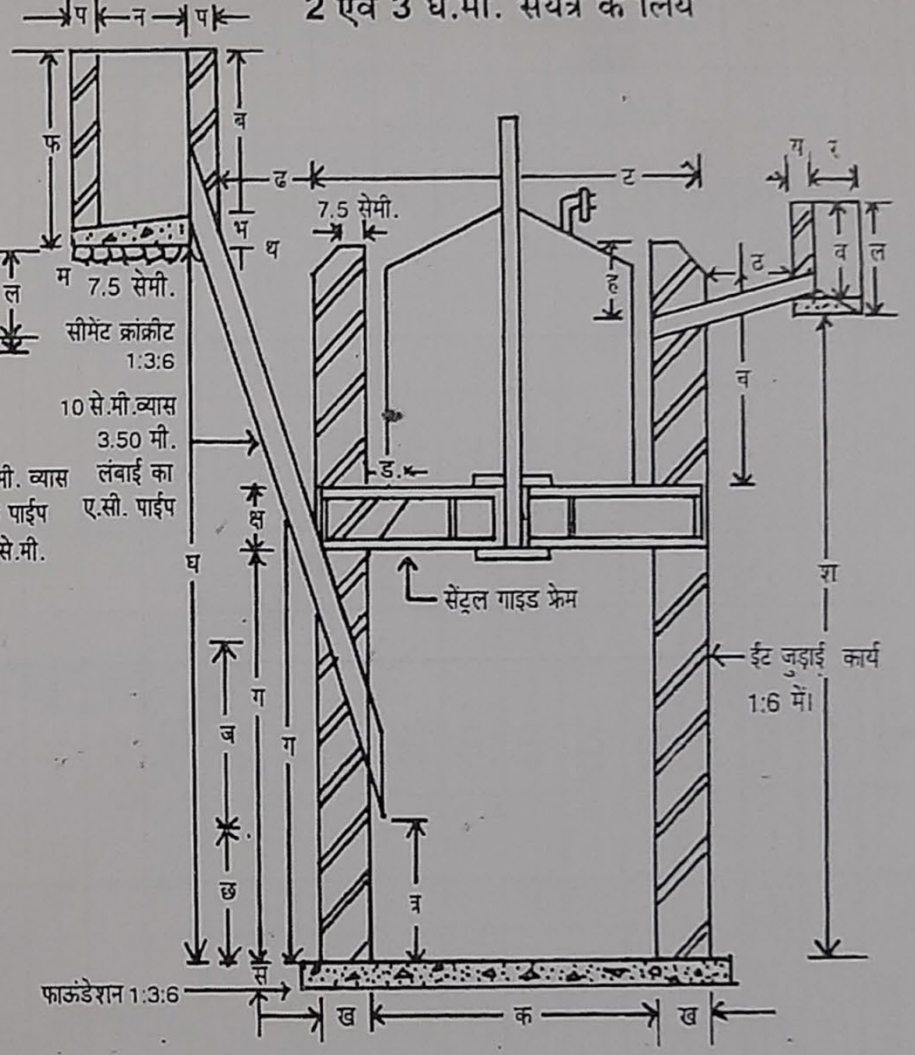
के.वी.आई.सी. मॉडल

4 घ.मी. एवं अधिक क्षमता वाले संयंत्र के लिये



के.वी.आई.सी. मॉडल

2 एवं 3 घ.मी. संयंत्र के लिये

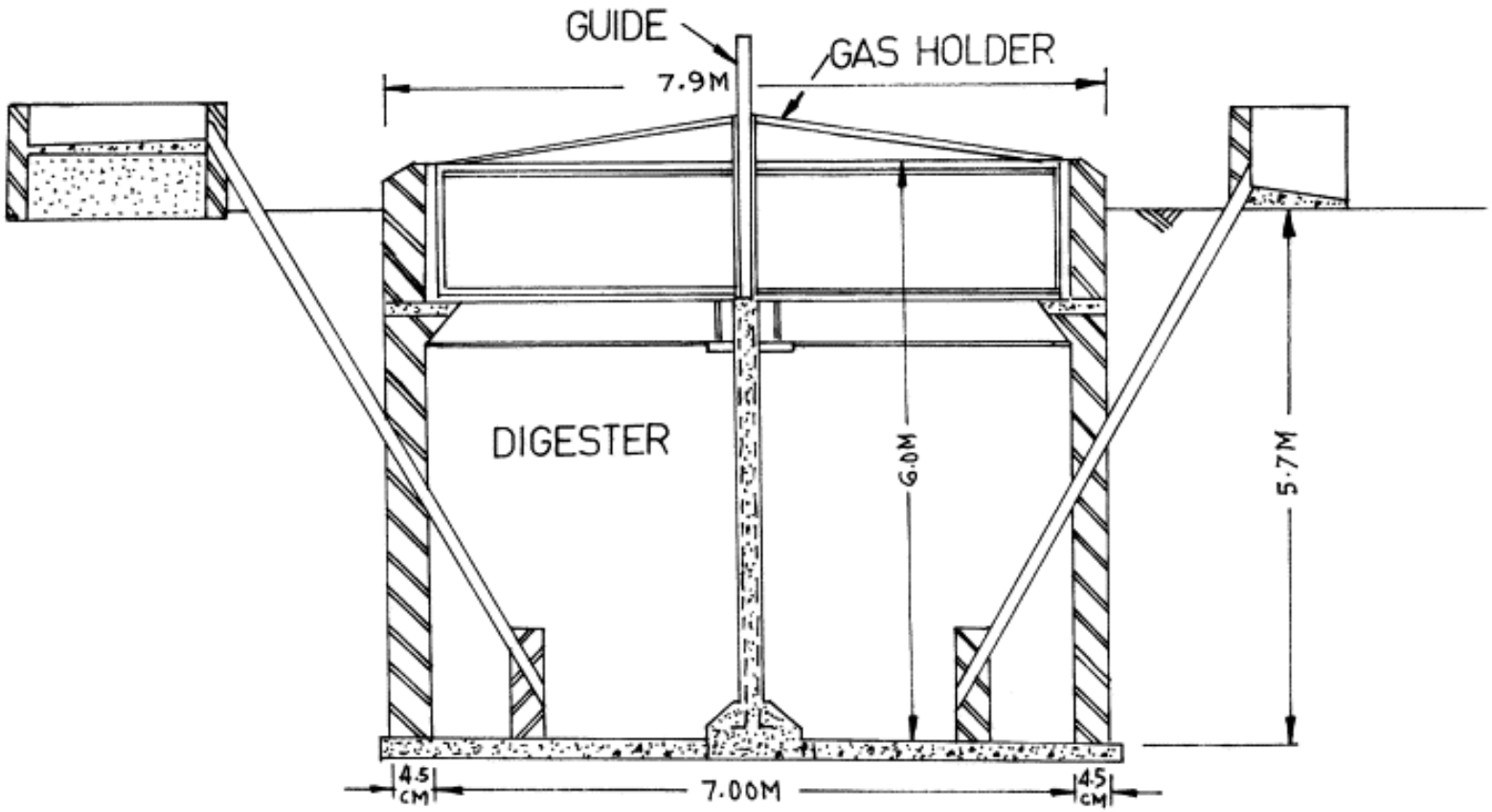


Guide Frame

A floating-drum always requires a guide frame for the following reasons:

- The floating-drum must not touch the outer walls.
- It must not tilt, otherwise the coating will be damaged or it will get stuck.
- It allows the gas drum to be removed for repair.

Guide frame



- Biogas production is a microbiological process,
- The process involves the combined action of 4 groups of bacteria in 4 stages.
- In first stage the degradation of cellulose, starch , protein fats etc. present in the organic materials take place into smaller molecular weight compounds like fatty acids, amino acids, carbon dioxide and Hydrogen. This is brought by a hydrolytic group of bacteria.

- In the second stage , the end products of the first stage are converted into acetate and hydrogen by acetogens.
- In order to produce more acetate, athird stage is involved, in which hemoacetogens, convert hydrogen and simple carbon compounds produce in first and second stage s into acetate.
- The fourth stage is conversion of acetate into CO_2, H_2 and CH_4. this is brought out by methanogens.

❑The Biogas Production Process Involves Three Stages Name

A. Hydrolysis

B. Acid Formation And

C. Methane Formation

- The process of degradation of organic material in every step is done by range of bacteria, which are specialized in reduction of intermediate products formed.

- The efficiency of the digestion depends how far the digestion happens in these three stages.

- Better the digestion, shorter the retention time and efficient gas production.

❑ Hydrolysis

- The complex organic molecules like fats, starches and proteins which are water insoluble contained in cellulosic biomass are broken down into simple compounds with the help of enzymes secreted by bacteria.
- This stage is also known as polymer breakdown stage.
- The major end product is glucose which is a simple product.

❑ Acid Formation

- The resultant product obtained in hydrolysis stage serve as input for acid formation stage bacteria.

- Products produced in previous stage are fermented under anaerobic conditions to form different acids.
- The major products produced at the end of this stage are acetic acid, propionic acid, butyric acid and ethanol.

Methane formation

- The acetic acid produced in the previous stages is converted into methane and carbon dioxide by A group of microorganism called "*methanogens*".
- They are obligatory anaerobic and very sensitive to environmental changes.
- Methanogens utilize the intermediate products of the preceding stages and convert them into methane, carbon dioxide, and water.

- It is these components that make up the majority of the biogas emitted from the system. Methano-genesis is sensitive to both high and low ph's and occurs between ph 6.5 and ph 8. Major reactions occurring in this stage is given below:

$CH_3COOH \longrightarrow CH_4 + CO_2$

Acetic acid — Methane — Carbon dioxide

$2CH_3CH_2OH + CO_2 \longrightarrow CH_4 + 2CH_3COOH$

Ethanol + Carbon dioxide — Methane — Acetic acid

$CO_2 + 4H_2 \longrightarrow CH_4 + 2H_2O$

Carbon dioxide — Hydrogen — Methane — Water

❑ Fixed dome Vs. Floating drum type

Sr.no	particulars	Fixed dome type	Floating drum type
1	initial cost	Less	More
2	Maintenance	Less	More
3	Effect of low temp.	Less	More
4	Pressure	Variable	Constant
5	Life time	More	Less (30 years)
6	Life of gas holder	More	5 to 8 years
7	Locating leakage & repair	Complex	Easy
8	Gas holding drum	Not present	Must
9	Utilization of space	More	Less
10	Efficiency	More	Less
11	Construction skill required	Skilled	moderate

Construction:

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

1.Slurry mixing tank - present above the ground level for mixing of dung and water.

2.Digester tank - Deep underground well-like structure. For more than 3 cum capacity, It is divided into two chambers by a partition wall in between.

3. Inlet and outlet pipes: It has two long cement pipes i) Inlet pipe for introduction of slurry. ii) Outlet pipe opening into the overflow tank for removal of spent slurry.

Both the pipes are located on either side of the digester.

4. Gas holder – It is an inverted steel drum type gas holder resting above the digester. The drum can move up and down i.e., float over the digester.

5. Gas outlet- The gas holder has a gas outlet at the top which is connected to gas stove.

6. Out let- For the removal of digested slurry.

7. Overflow tank- Present above the ground level for the flow of digested slurry from outlet.

Working:

- As the gas begins to accumulate in the drum, it starts rising in height but up to a certain level.
- The weight of the drum and pressure of accumulated gas apply pressure on the slurry in the digester.
- 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.
- 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.

•The weight of the drum applies pressure on the gas in the gas holder to make it pass through the pipeline to the point of use.

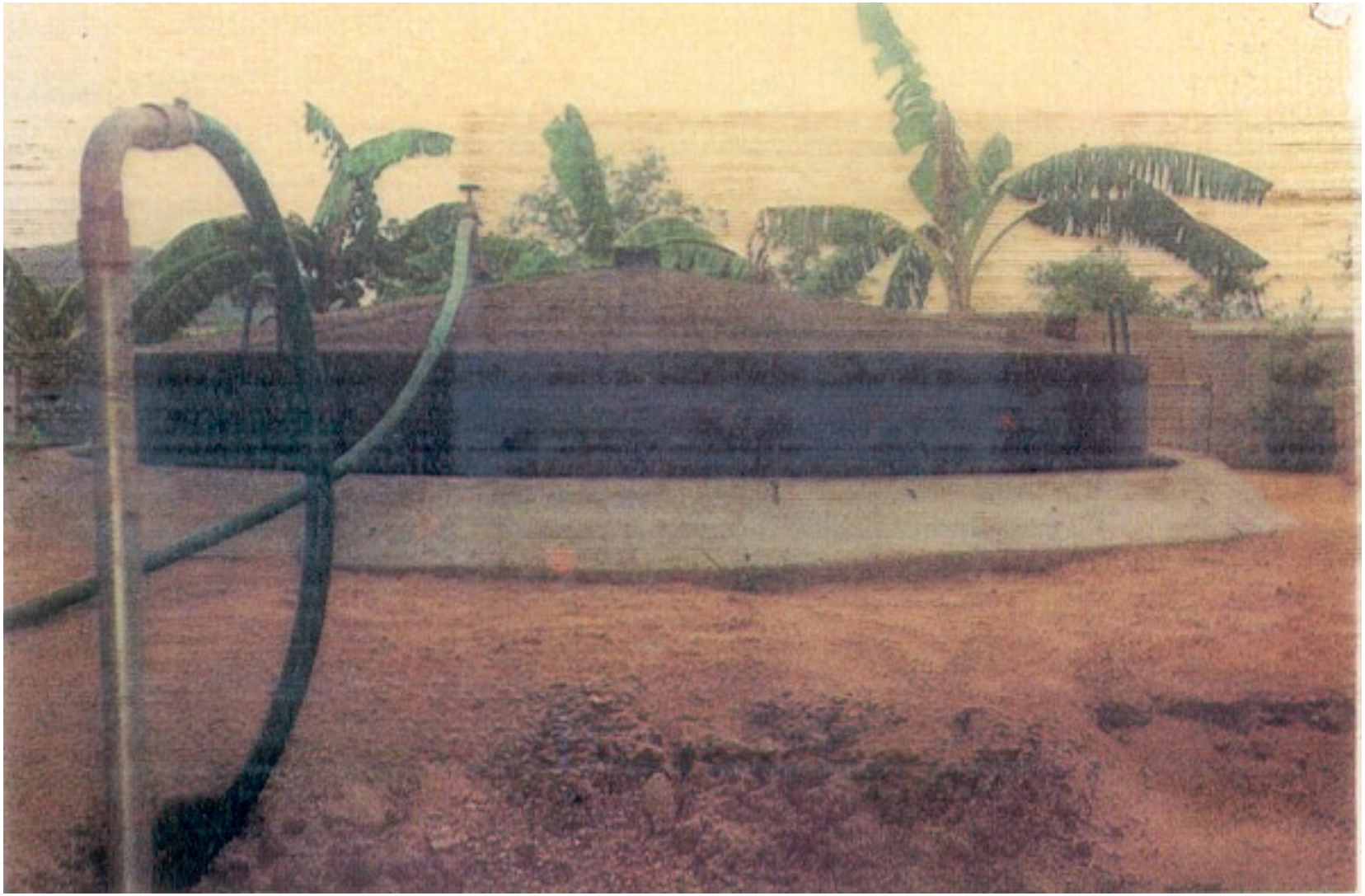
• Once the production of biogas begins, a continuous supply of gas can be ensured by regular removal of spent slurry and introduction of fresh slurry.

Advantages of KVIC plant:

1. Constant gas pressure.(about 10 cm of water column)
2. Minimum gas leakage problem.
3. Higher gas production per unit volume as compared to fixed type model.
4. Scum problem is minimum.
5. Local mason can construct.
6. Less chances of cracking.

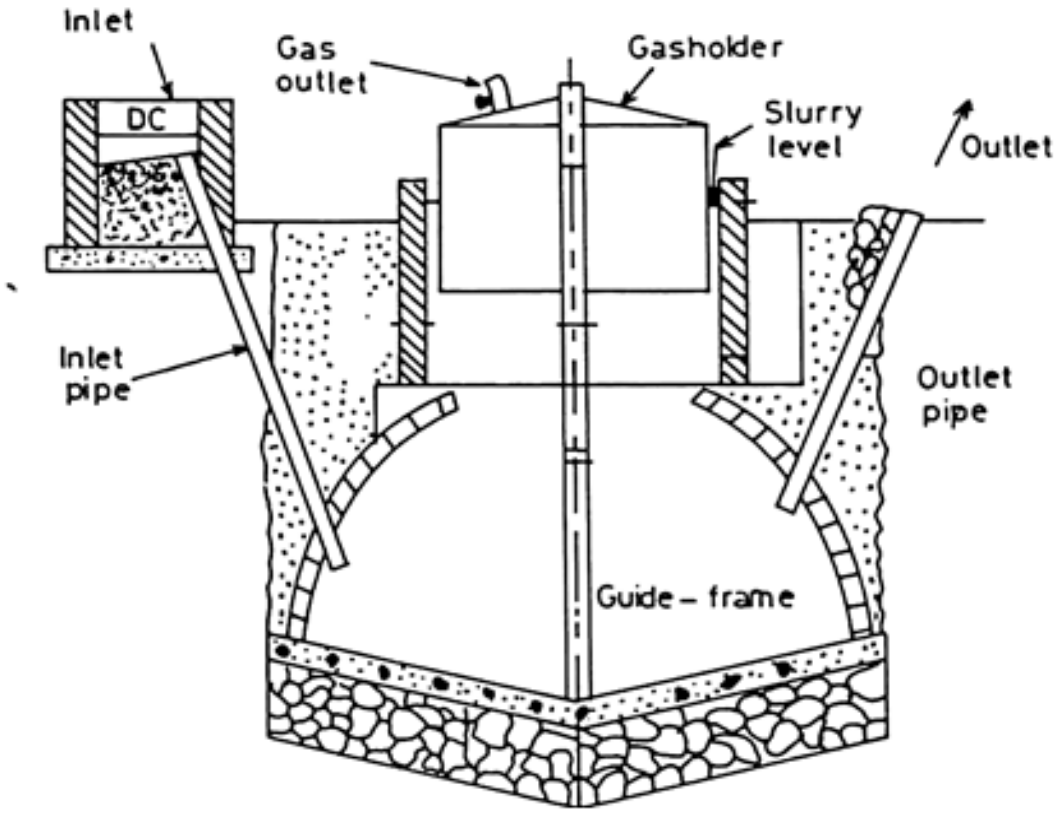
Disadvantages:

1.Higher cost.
2. Higher maintenance cost, drum is to be painted periodically.



IBP/CBP PLANT

PRAGATI MODEL



The Pragati model is a combination of Deenbandhu and KVIC designs, where the lower part of the digester is semi spherical with conical bottom and the floating drum acts as gas storage.

❑ Pragati Design

- Developed by united socio-economic development and research programme.
- It is cheaper floating drum biogas plant.
- Depth of pit is less than kvic plant.
- It can be constructed in hilly and high water table areas.
- Cost of this plant is 20% less than kvic plant.

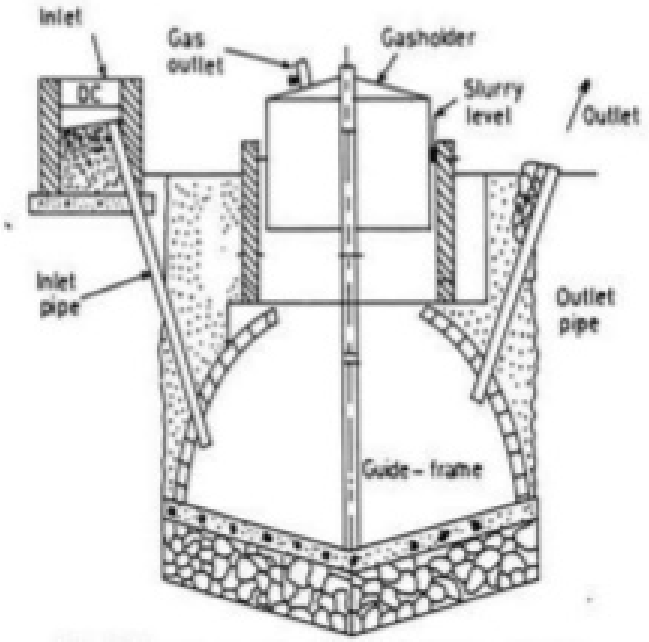


Fig. 4.20b Cross-sectional view of the Pragati Model