FACULTY OF AGRICULTURE SCIENCES AND ALLIED INDUSTRIES

Course Material

Course Name: Renewable Energy and Green Technology

Course Code: AGR- 222

B.Sc. Agriculture

Semester- II

Course Instructor

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Lecture-6

Size and Site Selection for Biogas plant

Sizing of biogas plant follows based on three parameters namely

- Daily feed,
- Retention time and
- Digester volume

The biogas plant size is dependent on the average daily feed stock and expected hydraulic retention time of the material in the biogas system. Capacity of the plant should be designed based on the availability of raw materials. Capacity of the plant indicates the quantity of gas produced in a day. Based on the study, 1 kg of cow dung along with equal quantity of water (1:1) under anaerobic conditions in a day produces 0.04 m^3 or 40 litres of biogas.

Based on the availability of cow dung, the capacity of biogas plant to be constructed can be calculated as follows

Example

i. 1 cow will yield an average of 10 kg of cow dung in a day. Assume a house is having 3 cows. Our objective is to calculate the capacity of the plant to be constructed.

ii. 3 cow x 10 kg/cow/day = 30 kg of cow dung/day 1 kg of cow dung will yield 0.04 m^3 or 40 litres of biogas. So 30 kg will produce 30x 40 = 1200 litres or 1.2 m^3 of gas in a day. So the capacity of the plant to be constructed will be 1 m^3.

Example

To produced 1 m^3 of gas in a day, quantity of cow dung required can be calculated as

1 m^3/ (0.04 m^3/kg of cow dung) = 25 kg of dung.

When a biogas plant is underfed the gas production will be low; in this case, the pressure of the gas might not be sufficient to fully displace the slurry in the outlet chamber. If too much material is fed into the digester and the volume of gas is consumed, the slurry may enter the gas pipe and to the appliances.

Table shows the quantity of cow dung required for different plant capacities.

Table. Plant size and daily feed stock requirement

Plant Size (m^3)	Daily dung required/day (kg)	Quantity of water required (litres)
1	25	25
2	50	50
3	75	75
4	100	100
6	150	150
8	200	200
10	250	250

Scaling of the digester

The size of the digester i.e. the digester volume is determined by the length of the retention time and by the amount of fermentation slurry supplied daily. The amount of fermentation slurry consists of the feed material (e.g., cattle dung) and the mixing water.

Example

25 kg of cow dung + 25 l water = 50 l fermentation slurry

The digester volume is calculated by the formula

Digester volume (l) = Daily feed (l/day) x Retention time (days)

Assuming the Retention time to be 40 days, then the digester volume can be calculated by

Digester volume = 50 (l/day) x 40 (days) = 2000 l or 2 m^3

Selection of construction site

Selection of construction sites are mainly governed by the following factors:

- The site should facilitate easy construction works.
- The selected site should be such that the construction cost is minimized
- The selected site should ensure easy operation and maintenance activities like feeding of plant, use of main gas valve, composing and use of slurry, checking of gas leakage, draining condensed water from pipeline etc.
- The site should guarantee plant safety.
- To make plant easier to operate and avoid wastage of raw materials, especially the dung/swine manure, plant must be as close as possible to the cattle shed.
- The site should be in slightly higher elevation than the surrounding. This helps in avoiding water logging. This also ensures free flow of slurry from overflow outlet to the composting pit.
- For effective functioning of bio-digesters, right temperature (20-35°C) has to be maintained inside the digester. Therefore it is better to avoid damp and cool place – Sunny site is preferable.

- To mix dung and water or flush swine manure to the digester, considerable quantity of water is required. If water source is far, the burden of fetching water becomes more.
- The well or ground water source should be at least 10 meter away from the biodigester especially the slurry pit to avoid the ground water pollution.
- If longer gas pipe is used the cost will be increased as the conveyance system becomes costly. Furthermore, longer pipeline increases the risk of gas leakage. The main gas valve which is fitted just above the gas holder should be opened and closed before and after the use of biogas. Therefore the plant should be as near to the point of application as possible.
- The site should be at sufficient distance from trees to avoid damage of bio-digester from roots.
- Type of soil should have enough bearing capacity to avoid the possibility of sinking of structure.

Location of biogas plant

A biogas plant should not be located further than 5 meters from the field. The digester chamber must be in an open area and should not be near any water source or natural water as animal excrement may seep into underground water. The plant should also be situated on a slope and not on the low land to avoid the danger of floods. The excess manure from expansion chamber should flow into the farmer's field or the storage tank and not into natural water bodies such as rivers to avoid the risk of pollution.

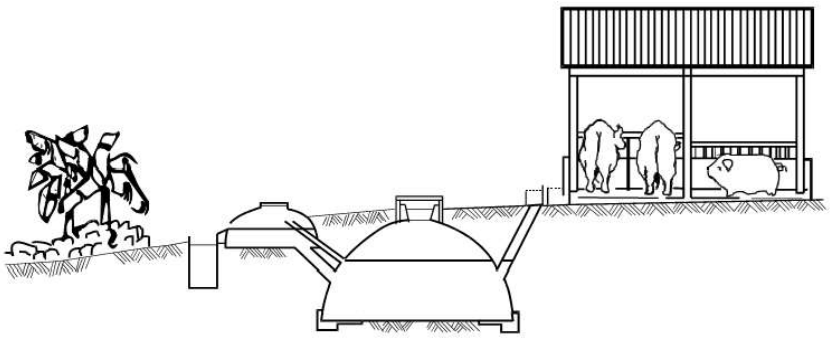

Fig. Location of biogas plant