

A. Description of Biogas.

Pakistan has low forest cover. About 4% of total area is covered by forest, in which only 5% area is protected. 90% of country's wood production is used as fuel. About 7000 ha of land is reforested in Pakistan every year. To control reforestation adoption of biogas is a best technology in Pakistan. Biogas technology has proved to be very successful in Pakistan. These activities will not only be beneficial to the human health but will also have positive impact on the environment

Biogas is produced by mixing dung (Animal waste) and water in the absence of oxygen through fermentation process. Biogas can provide a clean, easily controlled source of renewable energy from organic waste materials for a small labour input, replacing firewood or fossil fuels (which are becoming more expensive as supply falls behind demand). During the conversion process pathogen levels are reduced and plant nutrients made more readily available, so better crops can be grown while existing resources are conserved.

B. Composition of Biogas

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|---------------------------------------|--------|
| • Methane, CH ₄ | 50-75% |
| • Carbon dioxide, CO ₂ | 25-50% |
| • Nitrogen, N ₂ | 0-10 % |
| • Hydrogen, H ₂ | 0-1 % |
| • Hydrogen sulphide, H ₂ S | 0-3 % |
| • Oxygen, O ₂ | 0-2 % |

Composition depends upon the material feeded and process nature

C. Uses of Biogas.

- For cooking and heating food.
- For playing fan in summer.
- For lighting.
- Organic manure is its bye product.

The sludge product of anaerobic decomposition produces a better fertilizer and soil conditioner than raw manure. It nitrate e.g. nitrogen, phosphorous, potassium, plus trace elements.

D. Selection Criteria of Beneficiaries.

- The plant will be allotted to individual household.
- Land for construction of bio-gas plant should be available free of cost.
- Enough water should be available for feeding purposes.
- The individual household should have two buffaloes, preferably.
- Direct sunshine should be there throughout the day time on the proposed site.
- From environmental point of view, the plant should be out side of the boundary wall of the house. Plant should away 50 feet from kitchen.
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E. Location:

The most important consideration is the location of the plant.

- DO NOT dig the digester pit within 13 meters of a well or spring used for drinking water.
- If the water table is reached when digging, then site should be changed or it will be necessary to cement the inside of the digester pit.
- Try to locate the digester near the stable excessive time is not spent transporting the manure because fresher manure produce more methane.
- Be sure there is enough space to construct the digester. For 3 cubic meters of methane requires an area approximately 2 X 3 meters.
- Arrange to have water readily available for mixing with the manure.
- Plan for slurry storage. Although the gas plant itself takes up a very small area, the slurry should be stored either as is or dried. The slurry pits should be large and expandable.
- Plan for a site that is open and exposed to the sun. The digester operates best and gives better gas production at high temperatures (35degrees)
- Locate the gas plant as close as possible to the point of gas consumption. This tends to reduce costs and pressure losses in piping the gas. Methane can be stored fairly close to the house as there are few flies or mosquitoes or odor associated with gas production.

F. Design parameter:

i) Required Manure :

One buffalo can produce about 20 to 22 kg manure per day. Average 4 No cows or 2 No buffalos will produce about 45 kg manure per day .05 cubic meter.

The ratio of manure and water is 1: 1.

45 kg manure + 45 kg water = 90kg

Total input per day = 90 kg

Input for 5 weeks = 90 kg X 35 days = 3150 kg

1000kg = 1 cubic meter

3150 kg =3.1 cubic meters

So for a single household of average 7 people living is 3 cum plant is recommended

ii) **Temperature:** Normally required temperature will be 20o c to 35 o c

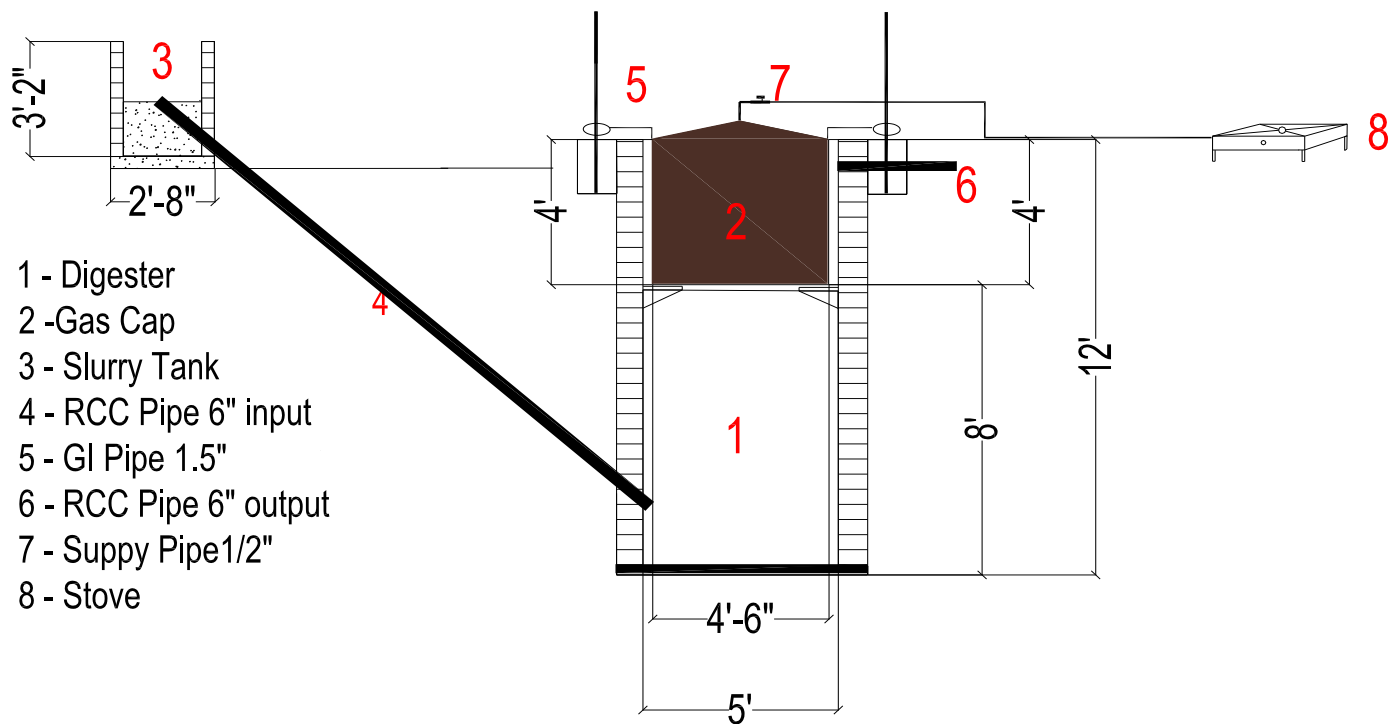
iii) **PH value:** Neutral PH and ranges 6.8 to 7.2

G. Construction Materials (For 3-Cubic-Meter Digester)

- Bricks approximately 2700
- Cement, 11 bags.
- Sand, 74 cft.
- Crush 9 cft.

- Steel sheet for gas cap 20'x4' of 16 gauge.
- RCC pipe of 6 inch diameter,12 feet.
- Angle iron 2 inch,10 feet.
- Mild steel rods, approximately 18. feet (for bracing)
- GI pipe ½ inch dia, and fitting as per requirement.
- Plastic pipe ½ inch dia, as per requirement.
- Stove 1 No.
- Waterproof coating (paint, tar, asphalt, etc.), 4 liters (for gas cap)

H.X- Section of 3M³.



I. Design/Construction.

- Prepare foundation.
- Dig a pit 6.5 feet in diameter to a depth of 12 feet
Line the floor and walls of the pit with bricks and bound it with cement mortar with the ratio (1:5)
- Put RCC pipe of 12 feet length from ground have one end of the input piping 3.5 feet above ground level and the other end 2 feet above the bottom of the pit.
- Keep angle iron on the brick wall about 8 feet height from the floor on three sides for the gas cap to rest on when it is empty.
- Extend the brickwork up to 1 feet above ground level to bring the total depth of the pit to approximately 12 feet.
- Plaster inside the plant with the ratio (1:4)
- Provide additional support for the pipe by fabricating across brace made from mild steel.

J. Design of Gas Cap Drum

The metal drum serving as a gas cap covers the fermentation tank and is the most expensive single item in the whole plant. The drum is made to hold between 60 and 70 percent of the volume of the total daily gas production. Usually drum from mild steel sheeting or galvanized iron sheeting of thickness 1.63mm (16 gauges). For 3 cum plant of 12 feet depth the height of the drum approximately one-third the depth which become 4 feet. Make the diameter of the drum 6 inch less than that of the pit (5 feet diameter).

Using a flange, attach a 1.5 inch pipe to the inside top center. Fix the lower end of the pipe firmly in place with thin, iron tie rods or angle iron. The cap now looks like a hollow drum with a pipe, firmly fixed, running through the center. Cut a $\frac{3}{4}$ inch diameter hole, as shown in Figure 7, in the top of drum for out let of gas. Weld a $\frac{3}{4}$ inch diameter pipe over the hole. Paint the outside and inside of the drum with a coat of paint or tar.

Make sure the drum is airtight. One way to check this is to fill it with water and watch for leaks. Attach handles to either side of the drum. These don't have to be fancy, but they will prove very helpful for lifting the drum off and for turning the drum. Weld a metal strip to each of the tie rod supports in a vertical position. These "teeth" will act as stirrers. By grasping the handles and rotating the drum it is possible to break up troublesome scum that forms on the slurry and tends to harden and prevent the passage of gas.

K. Prepare the Mixing and Effluent Tanks

Build or improvise a mixing tank to be placed near the outside opening of the inlet pipe. Likewise, provide a container at the outlet to catch the effluent. Some provision may also be made for drying the effluent when the plant goes into full production.

L. Operation

In order to start up the new digester, it is necessary to have 3 cubic meters (3000kg) of manure. Put the manure and an equal amount of water into the mixing tank. Stir it into thick liquid called slurry. A good slurry is one in which the manure is broken up thoroughly to make a smooth, even mixture having the consistency of thin cream. If the slurry is too thin, the solid matter separates and falls to the bottom instead of remaining in suspension; if it is too thick, the gas cannot rise freely to the surface. In either case the output of gas is less. When filling the pit for the first time, pour the slurry equally into both halves to balance the pressure on the thin inner wall, or it may collapse.

Mix 50 to 60kg fresh manure with same quantity of water and add it to the tank every day. The advantage of this model is that since the daily flow of slurry goes up the first side, where the insoluble matter rises, and down the second, where this matter naturally tends to fall, the outgoing slurry daily draws out with it any sludge found at the bottom. It can take four to six weeks from the time the digester is fully loaded before enough gas is produced and the gas plant becomes fully operational. The first drumful of gas will probably contain so much carbon dioxide that it will not burn.

On the other hand, it may contain methane and air in the right proportion to explode if ignited.

M. Test Gas Lines for Leaks

Checking for gas leaks is done by closing all gas taps, including the main gas tap beside the gas holder, except for one. Then to the open tap, a clear plastic pipe about a meter long is attached, and a "U" is formed. The lower half of the "U" is filled with water. Using a pipe attached to a second tap, pressure is applied until the water in the two legs of the "U" is different by 6 inch. The second tap is then closed. If the water levels out when the second tap is closed, a leak is indicated and can be sought out by putting soapy water over possible leaks, such as joints, in the pipe work.

N. Improved Stove

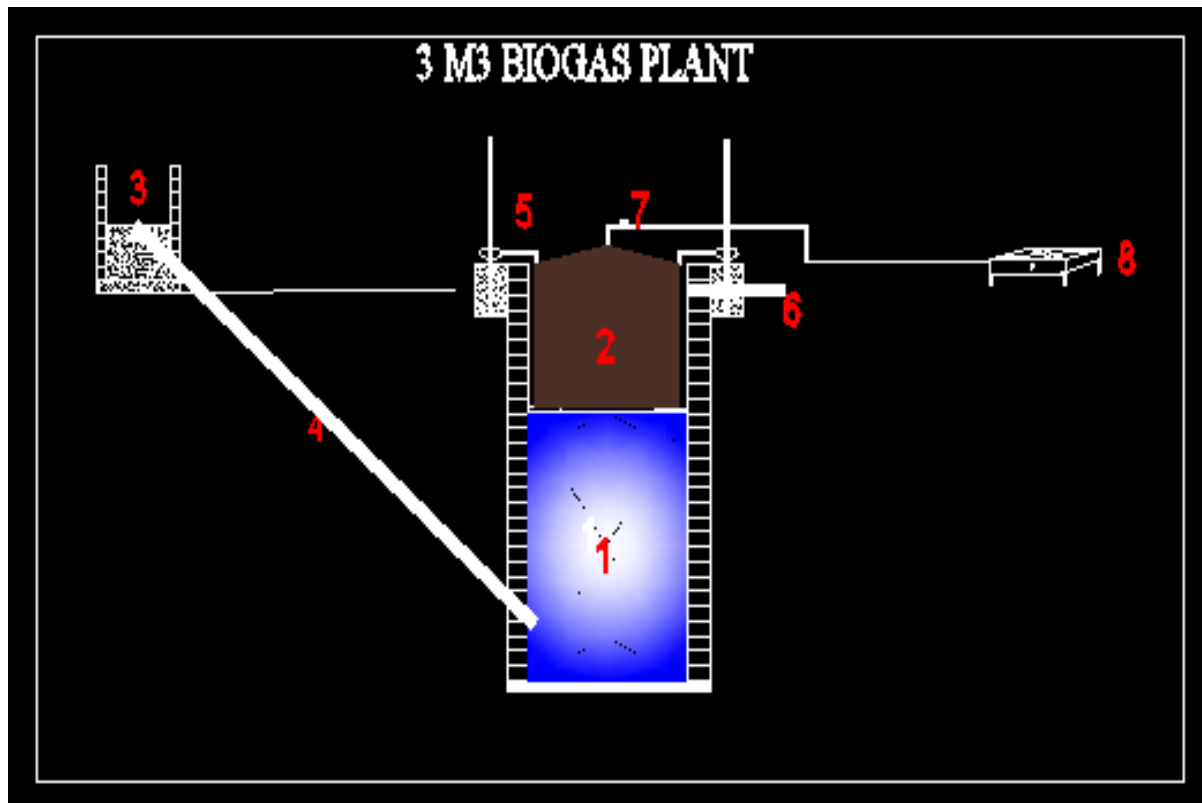
Because gas pressure is low, it will be necessary to modify existing equipment or build special burners for cooking and heating. A pressure stove burner will work satisfactorily only after certain modifications are made to the burner. The needle-thin jet should be enlarged to 1.5mm. To make a burner out of 1.5cm water pipe, choke the pipe with a metal disc having a center hole with a diameter of 1.5 to 2mm. An efficient burner is a tin can, filled with stones for balance, having six 1.5mm holes in the top.

The gas enters through a pipe choked to a 2mm orifice. Or fill a chula or Lorena stove with stones and insert a pipe choked to a 2mm orifice. If possible, it is best to use a burner with an adjustable air inlet control. The addition or subtraction of air to the gas creates a hotter flame with better use of available gas.

O. Maintenance

A digester of this type is almost maintenance free and has a life of approximately 25 years. As long as cow or other animal manure is used, there should be no problems.

MANUAL OF BIOGAS PLANT



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