

# Biogas Plant Users Manual

Fixed-dome Deenbandhu model digester:  
2 to 6 cubic meter size  
(measured as biogas generated per day)

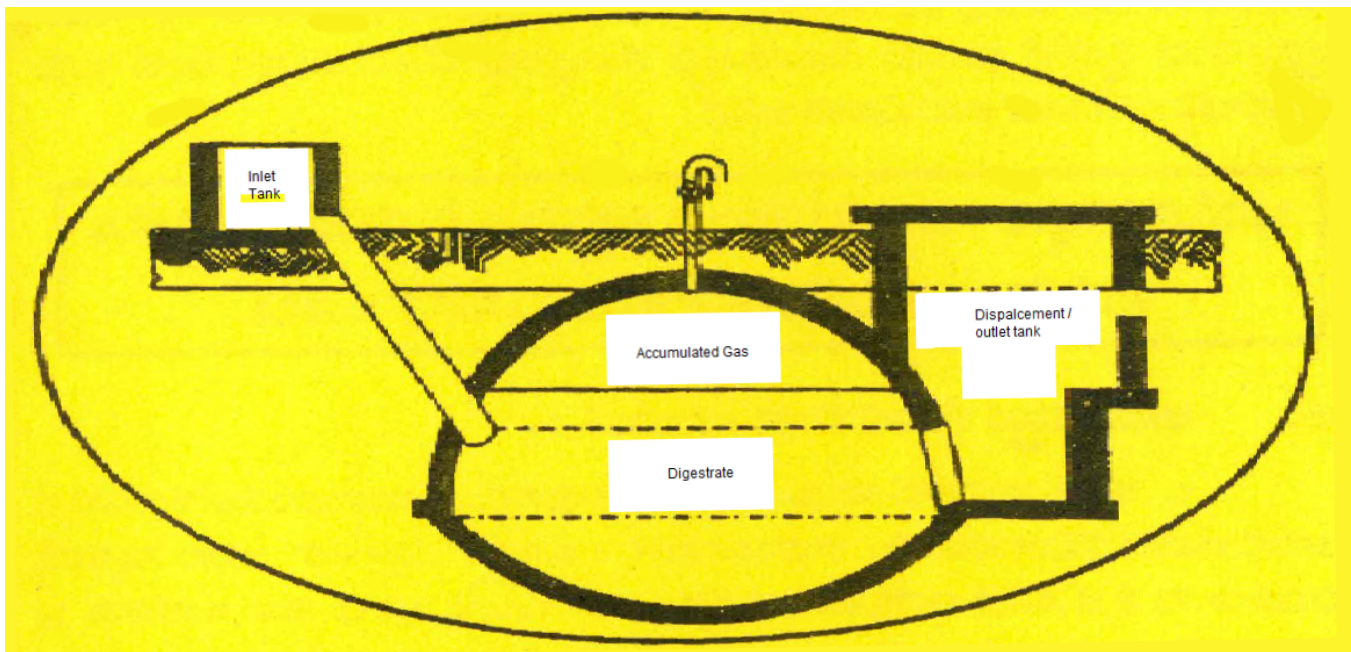


by  
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**Biogas – for clean surroundings and pollution control**  
**Use non conventional energy sources and save the environment**



### **1. Benefits of biogas**

The task of daily cooking requires gas, which is usually purchased as LPG. Obtaining LPG is becoming a problem due its scarcity in many places, such as the agrarian nation of Egypt. Rural women have to stand in a queue for several hours in the heat of the sun to get a cylinder. Domestic LPG is subsidized, but the cost to the government is high, so they are limited the number of cylinders a household can buy in a month. People who buy extra cylinders on the open market have to pay between three and six times the subsidized price.

A family owning animals has another problem. Animal sheds are cleaned once in a few days and the material dumped outside the shed. This attracts flies and mosquitoes and leads to unhygienic conditions in the house and can cause diseases. People often add food waste to the pile, which only increases the smell and the pests.

Both these problems can be solved if a biogas plant is installed. The animal dung can be treated in a hygienic way, which removes the smell and the pests, and biogas is produced, which replaces LPG for cooking. Biogas is a secure source of sustainable energy, which will always be available as long as the plant is fed with dung. The spent slurry that come out from the plant offers a source of good quality humus for their soils. It is well fermented, does not smell or attract flies and mosquitoes. The concentration of available plant nutrients is increased by the microbial process, as compared with the ordinary dung. Biogas technology thus offers many different benefits including hygiene, a supply of cooking gas and much needed humus for soils.

## 2. The biogas unit

The biogas unit is a fixed dome model, using a design called the Deenbandhu design, which has been adapted by SKG Sanghas, India, for use in Egypt. The unit has a hydraulic retention time of 60 days, which means the slurry that is fed each day remains in the digester for an average of 60 days. The unit is constructed under the ground, which means the temperature remains stable and the gas production is optimized. It also saves space and the user can grow flowers and other small plants on it. The gas production depends on the size of the plant and the amount of gas generated is listed in Table 1, if the plant is fed with the amount of dung listed in the table. The burner supplied by SKG Sangha is a double burner with a stainless steel body. Each of the two burners uses 450 litres of biogas per hour. The amount of maintenance required is minimal if the plants are fed with the correct amount of dung and used each day.

Plant size/Item	2 m <sup>3</sup>	3 m <sup>3</sup>	4 m <sup>3</sup>	6 m <sup>3</sup>
Required fresh dung for daily feeding (kg)	50	75	100	150
Required irrigation water for daily feeding (liters)	40	60	80	125
Maximum gas storage (m <sup>3</sup> )	0.7	1.0	1.3	2
Hours of operation of a single burner	1.5	2.2	3	4.4

**Table 1. Details of performance of biogas plants of different sizes**

### **A biogas unit gives a clean environment, it enables cooked food to taste better and the spent slurry is good for soil fertility**

The slurry coming out of the plant should be collected properly. It can be added to any other waste coming from the cattle shed and which can be used in a compost pit. The slurry will speed up the composting process and improve the quality of the compost.

Properly collect the slurry coming out of the plant in the slurry tank. Add this slurry to the other waste coming from the cow shed in a compost pit to speed up the process of other material composting. This increases the quality of the compost. Application of this compost to soils increases the soil fertility and improves crop yields.

## **Guide for proper installation and maintenance of biogas plant**

### **Before installation:**

1. The size of the plant needs to be decided. Table 1 gives the amount of gas that can be generated from different amounts of dung and the size of plant that is required to generate that gas. The size of plant is determined by the amount of dung available each day and the requirement for cooking gas.
2. The site of the plant needs to be chosen. The plant should be close to the source of animal dung, so dung does not need to be carried a long way each day. The gas pipe from the plant to the kitchen should not be too long. The plant should be away from the water supply and not close to any trees.
3. The quality of the soil in which the plant is built should be good; the soil should be hard, so the sides of the holes do not collapse when they are dug.
4. The life time of the plant depends on the use of good quality materials. The aggregate should be broken, hard rock, such as granite. The sand must be free from earth and the bricks should be well burnt.
5. The plant must be installed by well trained and experienced masons.

### **After the installation:**

1. Masonry plant structures have to be cured with water for not less than 12 days.
2. The earth outside the plant should be well compacted.
3. The plant should be fed with dung and water, 4 portions of dung to 5 portions of water. The dung should be as free as possible of soil, sand and fibrous material, such as straw. The water should come from an irrigation canal or a ground water pump. Tap water should not be used. The dung and water should be mixed in together to form a slurry.
4. Once the plant has been filled with a slurry of water and dung, it should be left for 15 to 20 days for gas to be generated. The flammability of gas should not be tested at the main gas valve, as it could cause an explosion. The gas pipeline should be flushed with gas and the flammability tested at the gas burner.
5. The slurry reservoir should be covered with the concrete slabs, once the plant has been initially filled with slurry.

### **Biogas plant management:**

1. The plant has to be fed with the right amount of a slurry of dung and water every day.
2. The biogas that is generated should be used each day, as otherwise it will escape and pollute the atmosphere. Even if it not required for cooking, it should be burnt in the burner.



3. Care must be taken that no antibacterial materials, such as pesticides or cleaning materials, should enter the plant.
4. Only water from an irrigation canal or from a ground water pump should be used in feeding the plant. Tap water usually has chlorine in it, which acts as an antibacterial agent. If tap water has to be used, it should be left in an open container for at least 24 hours, to allow the chlorine to escape.

### **Use of biogas stove:**

1. The stove should not be used in the open air.
2. The knob has to be pressed before it can be turned to start or adjust the gas flow.
3. A flame is required to light biogas, a spark igniter does not usually work.
4. A matchstick should be lit before the gas valve is opened.
5. The air flow in the mixing tube should be adjusted until the flame turns blue. There is an adjustment disk just behind the mixing tube. This adjustment only needs doing occasionally.
6. The stove frame and the burner tops have to be cleaned regularly. Any spilled food should be cleaned off quickly, before it burns.
7. The stove should be completely serviced once a year, by a trained engineer.

### **Routine problems and solutions:**

1. **If there is a red flame in the stove burner:** the airflow needs to be adjusted.
2. **If the flame is variable and the gas does not flow properly:** there is probably water in the gas pipe, which should be removed.
3. **If there is not enough gas:** the plant is usually not being fed enough dung. If the plant is being properly fed, the gas pipe may be blocked with water, or there may be a leak in the gas pipe.
4. Accumulated slurry can be removed from the plant.

### **How to remove accumulated water in the gas supply pipe:**

1. The gas should be used, by burning it in the stove. The stove should then be disconnected from the gas line by removing the rubber hose (see Picture 1).
2. The hose should be placed on the floor, to allow water to flow out.



**Picture 1 Rubber hose connected to biogas stove**

3. The length of the gas line should be checked. If the pipe is sagging in any place, it should be lifted, so the water can run out, either towards the digester or towards the disconnected rubber pipe.

### **Removal of over accumulated slurry form the plant:**

1. Once the gas has been fully used from the plant, the level of the slurry in the outlet tank should be checked. If the slurry level is more than 50 mm from the bottom of the reservoir tank, some slurry should be removed.
2. The gas valve should be opened and the rubber hose removed from the stove, so that no gas remains in the digester.
3. The concrete slabs over the reservoir tank should be slid off the tank, so that slurry can be removed from the tank with a bucket until on 20 to 30 mm of depth remains above the bottom of the tank.
4. The rubber pipe should be reconnected and the main gas valve closed.
5. The gas should not be used for 12 hours and the slurry level in the reservoir monitored. The slurry level should rise by around 200 mm.
6. If the slurry level does not change then either the plant has failed or there is a leak in the gas pipe. Help should be sought from the person responsible for supervising the plants.
7. The slurry level in the reservoir tank should be checked once a month.

### **General maintenance:**

1. The plant should not be fed with slurry when the stove is in use.
2. The slurry should be allowed to flow out of the exit hole easily and the exit hole should not be blocked. If slurry dries in the hole, it should be scraped away.
3. The level of the slurry in the collecting tank should be at least 100 mm below the hole. The tank should not be more than 600 mm deep.

### **Long term maintenance**

1. Every five years, the slurry should be removed from the plant completely. The digester should be flushed with water, so that biogas cannot be generated. Any sediment should be removed.
2. A coat of cement water should be spread over the entire inside portion of the digester using a brush. The slurry that had been removed can be used to feed the plant again after 3-4 hours of cement coat application.

### **Dos and Don'ts:**

1. The reservoir chamber should always be covered with the concrete slabs provided.
2. The required quantity of slurry made from a mixture of dung and water should be fed every day.

3. The mouth of the inlet pipe is closed with a piece of wood or with a stone. The dung and water are put in the tank and mixed together. Floating particles can be removed. The mixed slurry can be left to absorb the heat of the sun before it is fed into the plant. The wood or stone is removed and the warm slurry allowed to flow into the tank.
4. The dung should be fresh and free from any chemicals and antibiotics.
5. All chemicals, especially cleaning materials and anything containing antibiotics should be kept away from the digester.
6. The spent slurry should flow easily out of the reservoir tank.
7. The main gas valve and gas line should be protected against damage, especially from animals.
8. All the parts of the stove should be cleaned after it is used for cooking.
9. Ensure that the flame of the stove is just below the base of the cooking pots.
10. Soil should always cover the top of the digester. If soil is washed away, it should be replaced.
11. The slurry should be used to improve compost.
12. If slurry mixed with compost, the compost will break down more quickly and its quality will be improved.
13. If gas is released in the house, open all doors and windows and shut off the main gas valve. If the gas release is caused by the stove going out. Close the gas tap on the stove. If the rubber pipe has split or come off the pipe nipples, the rubber pipe should be replaced. Biogas does not explode easily.
14. If the gas pipeline is changed, such as by adding an extra branch, all of the joints must be leak tight.
15. If the pipe line is fixed to a tree, allowance should be made for the tree moving in the wind, by allowing extra pipe.
16. The end of the gas supply pipe should be at least ½ meter from the stove.



Inlet Tank



Outlet tank



Main gas valve



Slurry Discharge hole



Sagging pipe line



Stove knob

**Picture 2 Useful photographs of parts of a biogas plant**