HOW TO INSTALL A POLYETHYLENE BIOGAS PLANT

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1. WHAT IS A BIOGAS PLANT ?

A biogas plant is commonly known as a BIODIGESTER. The biodigester is a technology that takes advantage of excrement from animals and humans in order to transform it into BIOGAS (methane gas) as a source of fuel, and ORGANIC FERTILIZER.

Biogas is produced by bacteria that decomposes animal manure. The residual material is known as effluent and is very high in nutrients, thanks to the bacterial action and absence of oxygen. These factors help to eliminate bad smells and pathogens as well.

A plastic bag, an outgoing biogas valve and a security valve compose a biogas polyethylene plant.

Fig 1. The biogas plant. Gampaha, Sri Lanka

2. BENEFITS OF BIOGAS TECHNIQUE

Biodigesters can be fed with animal and human excrement. For this reason, biogas plants help to diminish illnesses and reduce the population of insects like flies and mosquitoes.

Thanks to biogas production, it is no longer necessary to use firewood to cook. The use of firewood affects the environment because it promotes the destruction of the forest and it also causes respiratory illnesses to people who cook with it. Biogas also saves money, replacing electricity or liquid gas as sources of energy for cooking.

Effluent from the biogas plant can be used as organic fertilizer, and the application of chemical fertilizers can therefore be reduced. This way, farmers save money, and pollution of the atmosphere by chemical inputs is avoided. The same effluent can be used in fish ponds and to produce aquatic plants. Aquatic plants produce enough material to feed animals and/or to make compost.

3. STEPS TO INSTALL A BIODIGESTER FOR A RURAL FAMILY

Step 1: Materials

The recommended biodigester length for a small family is 10 meters. To install a biogas plant of this size, the materials listed below are needed:

- 28 meters of natural polyethylene plastic, 1000 gauges, 1.5 meters width.
- 8 used buckets (~20 L) of the same size or 2 cement pipes, 1 meter length, 12 inches in diameter
- 1 PVC screw (male adapter),1 inch in diameter
- 1 PVC cap (female adapter) 1 inch in diameter
- 2 meters of transparent plastic hose of 1 ¼ inches in diameter
- 1 PVC "T", 1 inch in diameter.
- 2 - 90º PVC elbows, 1 inch in diameter
- 1 meter of pressure PVC pipe, 1 inch in diameter
- 1 flat PVC cap ,1 inch in diameter
- 2 round plastic or aluminum disks (20-15 centimeters in diameter with a central hole of 1 inch)
- 1 transparent plastic bottle - 1 gallon of capacity
- 3 used tires automobile tubes (rubber belts)
- 8 used plastic fertilizer sacks
- 1 galvanized metallic pipe, ½ inch in diameter 50 centimeters length
- 1 tube of PVC glue
- 1 steel wool
- An automobile or motorcycle as source of exhaust
- 1 plastic hose to take exhaust from the car to the place where the biodigester will be installed

Figure 2. Location where the biogas plant will be installed. Gampaha - Sarvodaya District Center, Sri Lanka.

Step 2: Biodigester location

Once all the materials are obtained, the biodigester location needs to be decided. The biodigester should be close to the animals, and it is also recommended to connect any human latrines to the biogas plant to eliminate another source of pollution. Lastly, the location should be near the kitchen where the biogas will be used.
Next, proceed to dig a grave in the ground. This grave is needed to protect the biodigester from any damage (from wild and domestic animals) and to help to maintain an appropriate atmosphere for the production of biogas.

An inclined gutter should be dug at each end of the grave. It should be the same width as the cement pipes.

It is necessary that the floor of the grave is in no way sloped, or else, the system will not work. Also, the walls should be totally flat and free of stones or roots that can break the bag.
Dimensions for the grave are as follows:

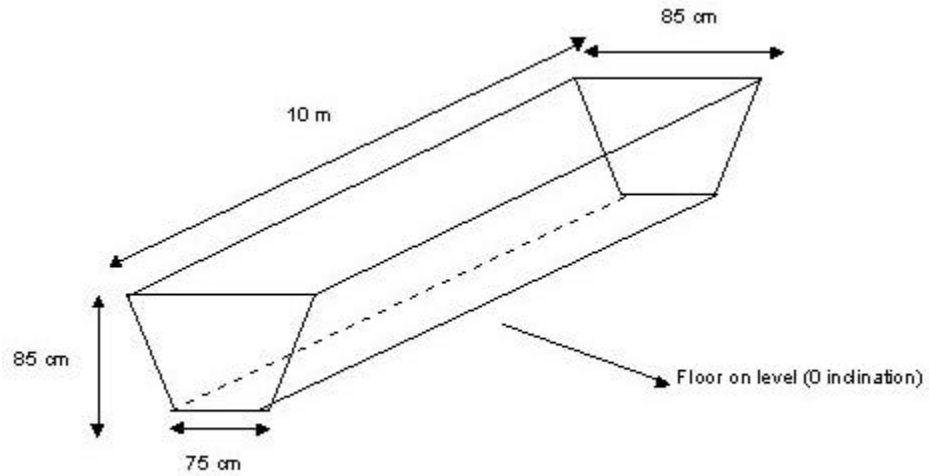


Figure 3. Dimensions of the grave, calculated for a plastic bag 1.5 m width.

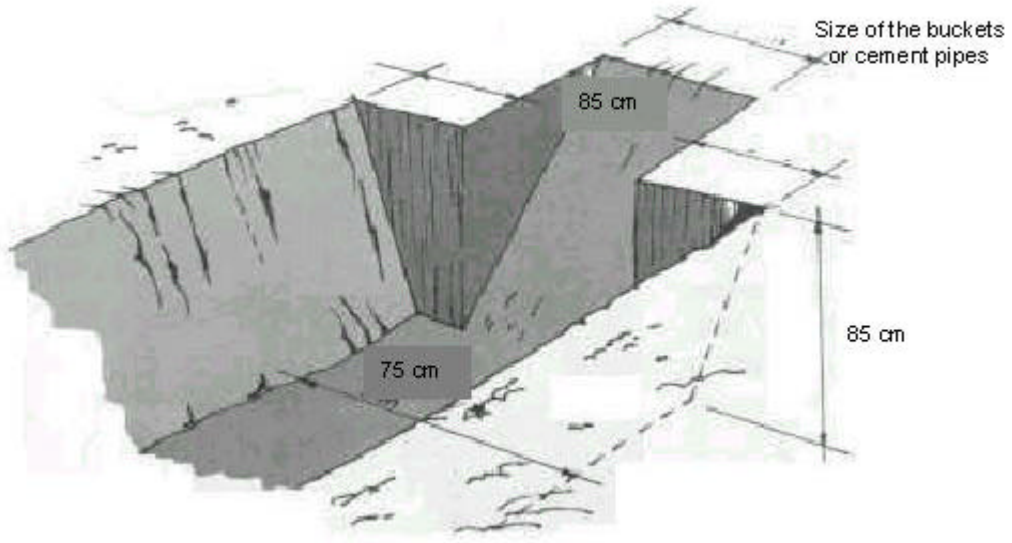


Figure 4. Details of the dug that should be dug at each end of the grave. Source. Botero *et al.*, 1999.

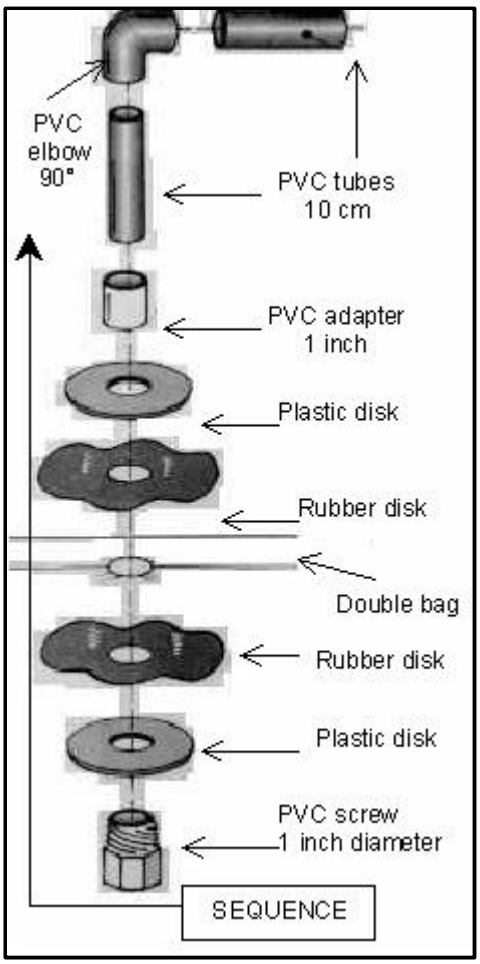
Fig. 5. Preparing the plastic bag. A person pulls one plastic bag thorugh the other.

Step 3: Preparing the plastic bag

Extend the 28 m plastic bag on a flat floor that does not have any stones that can break it. It is better if this process is carried out in a hall room of the community centre. Then, fold the plastic in half and cut it in two 14 meters pieces.

Next, a person (with no belt, rings or anything that might break the bag) introduces the second bag into the first one by pulling it through the 14 m length of the bag. When the second bag has been pulled through, the system is now a double bag, 14 meters in lenght. Now, the bag is ready and should be folded and stored in a safe place until the day of installation.

Fig 6. Sequence of the installation of the outgoing biogas valve.



Step 4: Outgoing biogas valve

Four meters from one end of the double bag (nearest to the kitchen), make a small cut (¾inch) to introduce the 1 inch PVC screw. Between the screw and the double bag, place a plastic disk and a rubber disk (piece of used tire). Then, outside the double bag, place another rubber disk, then a plastic disk and the PVC adapter.

Next, place a 10 cm PVC tube, the PVC elbow and the second 1 inch PVC tube. Finally, place the plastic bag with the outging valve in the grave and pass the two ends of the double bag through the 1 meter cement tubes. Instead of cement tubes, you can use plastic buckets. Remove the bottoms of three buckets and connect them together to make a pipe. . You will need 4 buckets at each end (8 buckets total).

Step 5: Security valve

Next, the **security valve** should be placed according to the following:

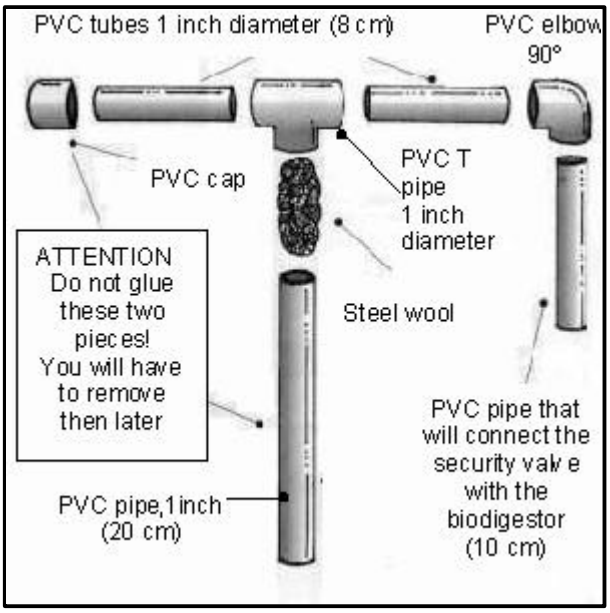


Figure 7. Diagram of the security valve.

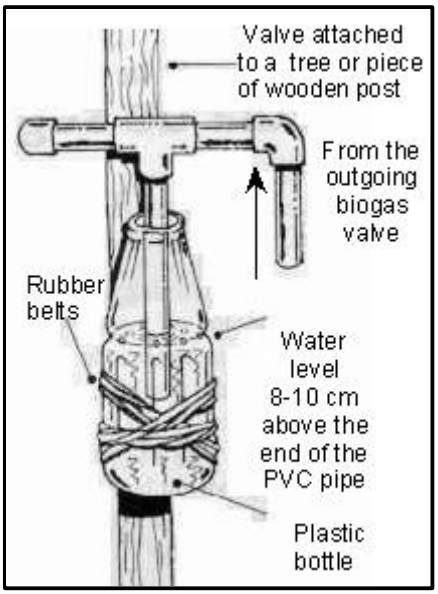


Figure 8. The security valve is tied to a wooden post.

ATTENTION: Make sure the **20 cm PVC tube**, **is not glued to the "T"**. Every **six months**, the Steel wool **needs to be changed**, without dismantling the rest of the system.

Insert the valve into a transparent plastic bottle, full of water, and tie it to a wooden post (next to the exit valve). Make small holes in the plastic bottle to ensure that the 20 cm PVC pipe is 8-10 cm under the water level.

Finally, the outgoing biogas and security valves are connected through the transparent plastic hose.

Step 6: Fill up the biogas plant with exhaust and water

Tie one end of the double bag with rubber belts, and insert a hose into the other end. Connect this hose to the exhaust pipe of a car, making sure it is well attached. Start the engine, and let it run until the bag is full. When the outgoing biogas valve starts to bubble, that indicates that the biodigester is at its maximum capacity.

Figure 9. Connecting a hose to the exhaust pipe of a car, in order to fill the plastic bag with exhaust.

Next, through the same hose, fill the biodigester with water, until it reaches the level of the buckets, and the gas can no longer escape. This is a critical step, because if it is not carried out correctly, the bell where the biogas will be stored will not form.

Figure 10. Photo of a biogas plant, filled with exhaust and water.

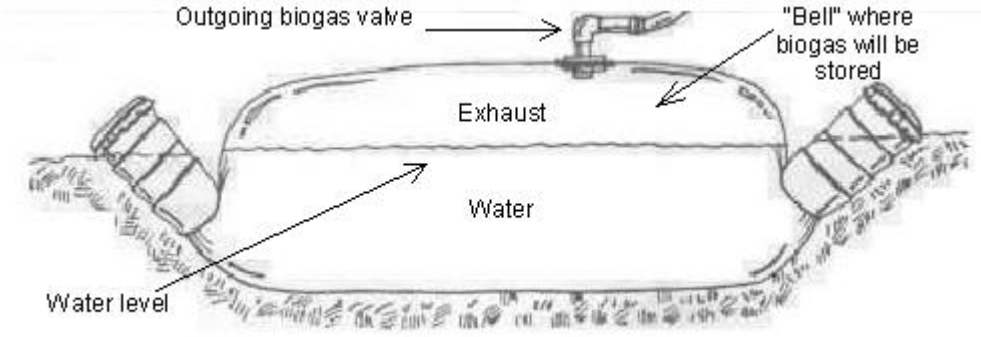


Figure 11. Diagram of a biogas plant, full of exhaust and water.
Water represents 75% of the total volume of the bag.
The other 25% is full of exhaust.

Figure 12. When water reachs the level of buckets, both ends are opened. Water level keep gases inside the bag, forming a bell.

At this point, open both ends of the plastic bag. The bell should be formed and biogas will not escape.

Step 7: Management of the biogas plant

Daily, the biogas plant must be fed with 18 kilos of FRESH excrement (from cows, buffaloes, goats, pigs, etc.) blended with 90 kilos of water. This is approximately a mixture of 1 bucket of excrement with five buckets of water. This mixture is needed to replace the water lost during the process and keep a flowing material inside the biodigester.

YOU SHOULD **NEVER** CHARGE THE BIOGAS PLANT WITH **CHICKEN MANURE**. This is not appropiate for biogas production.

Figure 13. The biogas plant should be fed every day with fresh manure. Manure is blended with water (1:5) and then through to the biodigester.

Step 8: Protection of the biodigester and use of organic fertilizer

In order to protect the plastic bag from sunlight and animals, a roof and a fence should be built. This will extend the life of the biogas plant (10 years)

Dig a hole next to the end of the biogas plant to collect the effluent which can be used as fertilizer (see figure). This fertilizer can be utilized for orchards or to produce aquatic plants for animal consumption or composting, as well as in ponds for breeding fishes.

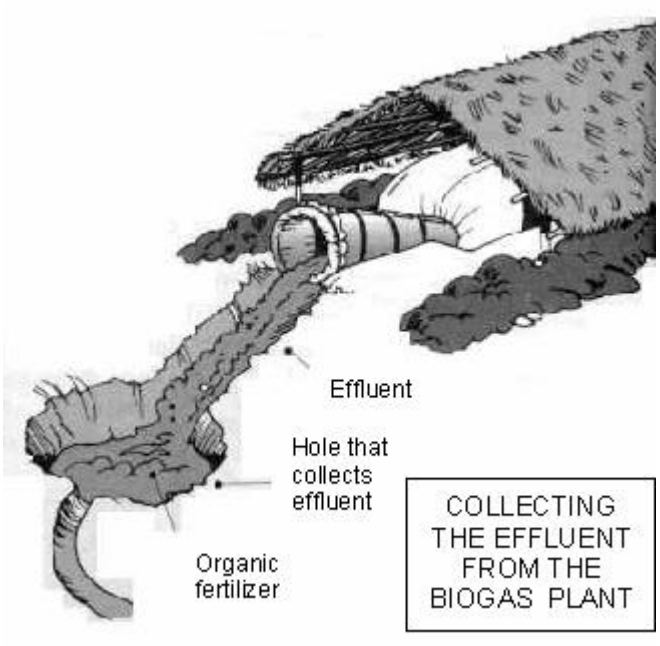


Fig 14. The effluents from the biodigester can be used directly as organic fertilizer or to produce aquatic plants, that then can be used to feed pigs or produce compost.

Step 9: Install the burner

30 days after the installation of the biogas plant, remove the PVC cap from the security valve and connect the end of the PVC pipe to the burner. All connections should be made with plastic or PVC pipe, because the biogas is corrosive. Only the pipe that will be used to burn the biogas is galvanized iron.

Figure 15. Biogas is brought to the kitchen using PVC connections, due to its corrosive action. Only the last tube is a iron galvanized pipe. A biogas plant can produce enough fuel to fulfill the requirements of a rural family.

Through the application of biogas technology the quality of life can be improved, save money and increase productivity of the farm and the same time, while protecting our natural resources. This simple and cheap technology can be applied everywhere in the Tropics.

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