

Biodigester installation manual

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Full manual at

<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/FRG/Recycle/biodig/manual.htm>

Deciding on the location of the biodigester and excavating the soil to make the trench

The first step in installing the biodigester is to identify the most appropriate location. In general this should be close to the source of the livestock pen where the waste is produced. It is a distinct advantage if the washings from the pen pass by gravity directly to the inlet of the biodigester. It is relatively easy to transport the gas by pipeline but difficult and tedious to do this with liquid wastes.

As a general rule the excreta produced by 10 fattening pigs will require a biodigester of 4 m³ liquid capacity. For a small number of animals, it is advisable to use a diameter of 80cm, which then needs a length of 10 m.

When digging the trench it is important to observe the following:

- The sides and the floor should be smooth with no protruding stones or roots which could damage the plastic film
- The floor should have a slope of about 2.5% from the inlet to the exit (this would be 25cm for a biodigester of 10m length)
- The soil that is excavated should be moved away from the edges of the trench so that movement around the biodigester during or after installation, or subsequent heavy rains, do not cause soil to fall onto the plastic



Photo 1. Excavating the soil

Preparing the plastic tube

If the biodigester trench is 10m long then an additional 75cm should be added to each end of the plastic tube to allow for wrapping the ends over the inlet pipes. Thus the length to be cut will be 11.5m.

Two lengths are required as one will be put inside the other to give added strength. When the second length of tube is inserted inside the first length, care should be taken to ensure that the two films fit snugly together and there are no folds or creases.



Photo 2. Bundling one plastic tube in preparation for putting it inside the other



Photo 3. Putting one plastic inside the other to give added strength

Materials required for the biodigester

- Transparent polyethylene tubular film, the diameter of which varies according to the capacities of the machines installed in the factories, but is usually in the range of 80 to 200cm (equivalent to a circumference of 2.5 to 6.3m). The calibre (thickness) should be in the range of 800 to 1,000 (200 to 250 microns). The length of the tube is determined by the size of the biodigester. The most appropriate material is that which is used for greenhouses as this usually contains an ultraviolet (UV) filter which helps to prolong the life of the plastic when fully exposed to the sun (see Photo 69).
- 2 ceramic tubes of 75 to 100cm length and 15cm internal diameter.
- Plastic (PVC) hosepipe of 12.5mm internal diameter (the length depends on the distance to the kitchen).
- 2 PVC adapters (male and female) of 12.5mm internal diameter.
- 2 rubber washers (from car inner tube) of 7cm diameter and 1mm thickness with a 12.5 mm diameter central hole.
- 2 rigid plastic (perspex) washers of 10 cm diameter and a central hole of 12.5mm. Although perspex is best, these washers can be cut from different sources such as old plastic buckets and other materials made from strong plastic.
- 2 m of PVC pipe of 12.5mm internal diameter.
- 4 used inner tubes (from bicycle, motor cycle or motor car) cut into bands 5 cm wide.
- 1 transparent plastic bottle.
- 1 PVC elbow of 12.5mm internal diameter..
- 3 PVC "T" pieces of 12.5mm internal diameter.
- 1 tube of PVC cement.

Fixing the gas outlet

The components of the gas outlet and the order in which they are placed in the plastic tube are indicated below

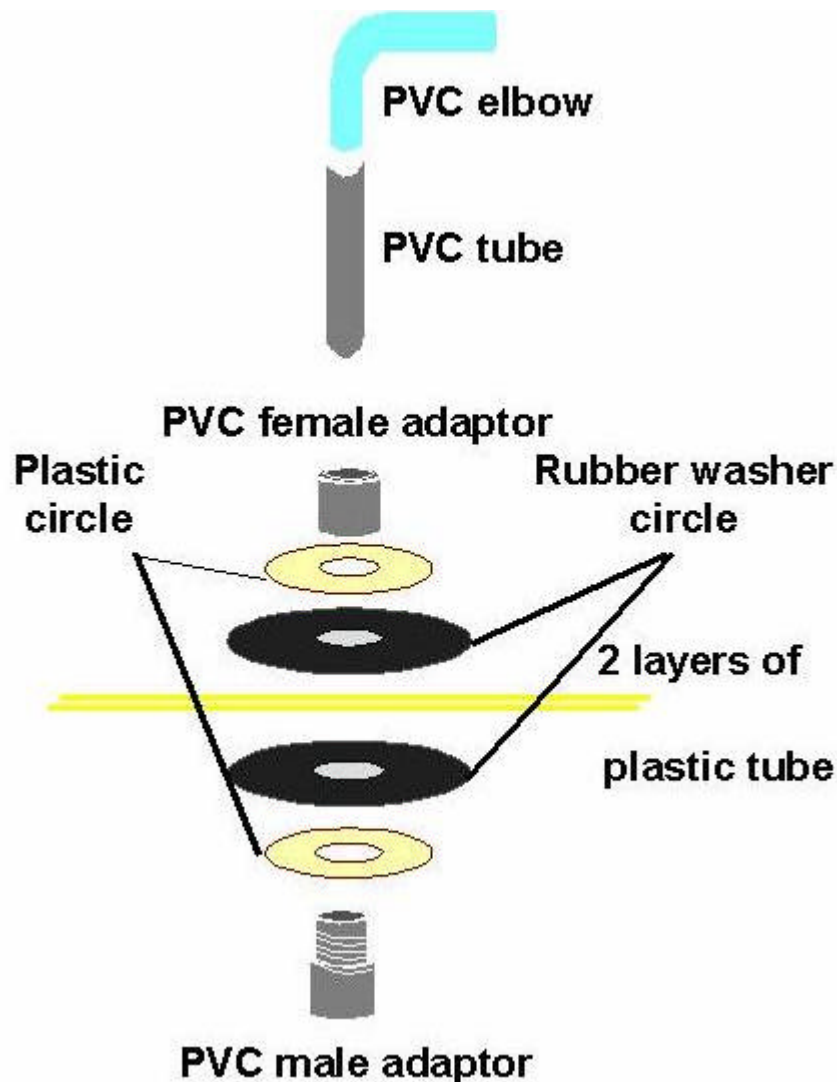


Figure 1. Materials for the gas outlet and the order of assembling them

The first step is to mark the place where the gas outlet will be placed. This should be 1.5m from the end of the plastic tube and in the centre of what will be the top of the biodigester.

The size of the hole is determined by the external diameter of the PVC male adapter. The rubber washer circles are cut from a length of "used" motor cycle or car inner tube, using the plastic (Perspex) circles as a guide.

The components are then assembled to ensure the male and female adapters fit together smoothly.

The male adapter, complete with plastic circle and above this the rubber circle, is inserted from within the plastic tube. The female adapter, with the rubber and plastic circles attached, is screwed tightly on the protruding male adapter.

The installation of the gas outlet is now complete.

Fixing the inlet pipe

Rubber bands 5cm wide are cut from "used" inner tubes (from bicycle, motor cycle or motor car).

A polypropylene sack (or one of similar material) is placed on the ground below the work area to avoid damage to the plastic tube.

The ceramic pipe is inserted to one half of its length in the interior of the plastic tube and the plastic tube is folded around it. The join is secured by wrapping the rubber bands around the pipe beginning 25 cm from the edge of the plastic and working towards the exposed part of the ceramic pipe, each band overlapping the previous one, and finishing on the ceramic pipe so that the edges of the plastic tube are completely covered.



Photo 4. Finishing one side



Photo 5. Wrapping the rubber bands around plastic tube where it overlaps the pipe

Filling the plastic tube with air

The inlet tube is closed with a square of plastic film (or a plastic bag) and a rubber band.

The exit of the female adapter is closed with a small square of plastic film and a rubber band.

The polyethylene tube is filled with air before being located in the trench. From the open end, air is forced into the tube in waves formed by flapping the end of the tube in a forward propelling movement of the arms. The tube is then tied with a rubber band about 3m from the end so that the air does not escape. This is to facilitate fitting the exit ceramic tube which is put in place using the same procedure as for the inlet pipe.



Photo 6. Pumping air



Photo 7. Tying the tube but leaving enough plastic to insert the outlet pipe

Final stages in preparing the plastic tube

The second ceramic pipe is fitted to the exit of the plastic tube using the same procedure as for the inlet.

It is very important that the edges of the plastic are completely covered by the rubber bands which are applied each overlapping the previous one, and ending on the ceramic tube. When the ceramic tube is fixed a square of plastic sheet, held in place with rubber bands, is used to seal the tube. The restraining rubber band, previously attached to prevent escape of air when the exit ceramic tube was inserted, is now removed. The bag will appear to deflate a little as air enters the final section previously closed by the rubber band. The final step in completely filling the bag with air is done by attaching a length (4m) of plastic tube (same material as used for the biodigester) to the ceramic exit pipe, filling this with air by the flapping procedure, and then removing the plastic sheet to allow this air to enter the main bag. The process can be repeated until the biodigester bag is completely full with air. The square of plastic, held in place with a rubber band, is again put in place to seal the exit pipe.

The inflated tube is then carried to the trench taking care that it does not come in contact with any object which might puncture it. It is lowered into the trench in such a way that the gas outlet is at the top of the tube. A support is prepared to hold the gas exit line. The gas line (13mm internal diameter PVC tube) is secured using PVC cement.

The bag is filled with water until the inlet and outlet pipes are sealed (covered with water) from the inside. The air inside the bag is now trapped in the upper part. Filling with water is suspended and the plastic bags over the exit and entry pipes can be removed.



Photo 8. Untying the plastic bag



Photo 9. Forcing the air from the 3m tube to the main tube



Photo 10. Placing the digester in the trench



Photo 11. Connecting the PVC pipe to the gas outlet

The water trap (gas escape valve)

A "T" is prepared from three pieces of PVC pipe, two short pieces and a longer one which will fit into a "used" plastic bottle.

A 3*3cm hole is cut in the upper part of the bottle, just below the neck, through which water will be added to form the gas seal.

Small holes are made either side of the neck to take a length of thin wire which will be used to attach the bottle to some support structure.

The PVC "T" is inserted in the bottle and water is added to a depth of 4-5 cm above the lower point of the "T"

Small holes are punched into the sides of the bottle at a point 2 cm above the lower end of the "T". This ensures that if the gas pressure inside the system exceeds 2cm water column the gas can escape to relieve the pressure.

The "water trap" is now suspended in a convenient place so that the water level can be easily observed and replenished when necessary

A flexible plastic pipe is attached to the gas outlet and joined to one arm of the "T". The other arm links with another plastic pipe which goes to the kitchen.



Photo 12. The PVC pipe is inserted into the bottle and a little hole is made to fix the water level



Photo 13. Joining the other end of the PVC "T" to the plastic hose that goes to the reservoir bag

The gas reservoir

This is a large plastic bag (4m length) of the same polyethylene tube used for the biodigester.

One end is closed using rubber bands from "used" car or motor cycle inner tubes.

A "T" made from rigid PVC pipe is fitted at the other end.

The reservoir is then located in a convenient place (for example, suspended in the roof space of the pig pen) close to the kitchen.

The arms of the "T" are connected to the gas line; the inlet to the biodigester and the outlet to the stove in the kitchen.



Photo 14. Tying with rubber band



Photo 15. The reservoir bag full of biogas

Taking the gas to the kitchen

With the reservoir in place, the gas line attached to the outlet arm of the "T" is fixed to the burners.

A strap is placed around the middle section of the reservoir. By pulling on the strap, and tying it to some fixed object or hanging a heavy stone or a brick, the pressure of the gas delivered to the burners can be increased. This is usually necessary when cooking proceeds over an extended period of time.

The time that elapses before gas is produced depends on the composition and quantity of the manure that is put into the biodigester. In certain farm households the washings from the pig pens may already be in an advanced state of fermentation when they are introduced into the biodigester. The farm family would thus be able to begin cooking with biogas only 5 days after the installation. With fresh unfermented manure the time lag is between 21 and 28 days.



Photo 16. Cooking with biogas



Photo 17. A string around the bag is used to increase the pressure

Protecting the digester



Photo 18. Fencing around the area where the biodigester is located



Photo 19. Roofing can protect the biodigester



Photo 20. In the small-holder farm the gas is enough to cook for the whole family