

# Bio-Gas Manual

By Andrea Kornfeld and Benjamin Doerr

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## Introduction

Farmers are always looking for ways to live more comfortably. One way to live more comfortably is to cook with gas instead of wood or charcoal. In many places, bottled natural gas is expensive to buy; however, it is possible to create your own methane gas from animal manure at your home. This is called biogas, and that is the name we'll be using throughout this brochure.

Some of the benefits of biogas are as follows:

- Less wood usage (better for the environment)
- Inexpensive and simple to construct
- Cooks quickly
- Does not produce smoke (cleaner and healthier)
- Manure and water can be re-used as green fertilizer
- Saves time and money that was previously spent looking for, or buying wood or charcoal

**It is important to read the entire manual before beginning construction.**

## ***What is bio-gas generator?***

A bio-gas generator is a stove that uses methane gas for cooking. Bio-gas is a natural, clean, burning fuel created from decomposing manure. It doesn't produce any smoke unlike charcoal or wood. Therefore, your cooking area will remain clean and you will remain in better health.

After all of the bio-gas has been produced, what is left is a rich green fertilizer that you can use on your fields.

This brochure is designed to help you understand and construct a bio-gas generator. Here is a picture of a bio-gas generator.



## ***How does it work?***

When animal manure decomposes, it naturally creates methane gas. The bio-gas generator produces and captures this gas, to be used for cooking.

In the diagram above, there is a large drum, an inner tube, and a stove. The drum is filled with a mixture of manure and water, which will create bio-gas that is stored in the inner tube. We can use the gas in the inner tube to cook on the stove.

Construction of the bio-gas generator is not easy and will take time. Also, it will cost money to construct. However immediately, you will see that you are saving time and money, which was previously, spent looking for, or buying wood or charcoal. Bio-gas cannot replace wood or charcoal use; however, it is ideal for preparing sauces, tea, baby food, and reheating food.

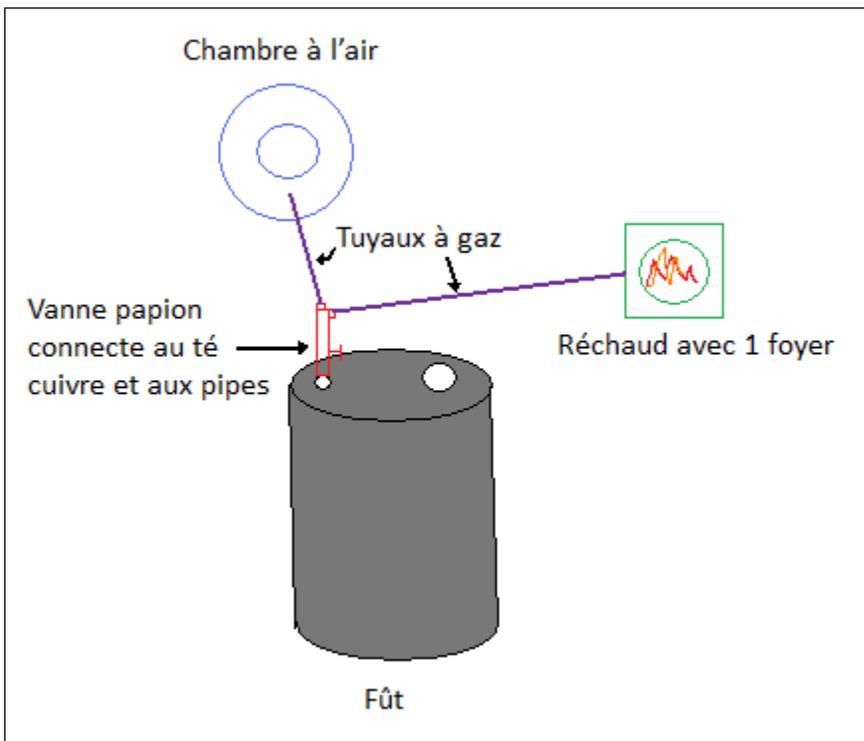
If it is very hot or cold in your village, it will be difficult to make your bio-gas generator produce gas. The ideal outside temperature for bio-gas production is between 32 and 37 degrees Celsius. If the temperature is less than 15 degrees Celsius, no gas will be produced.

# Constructing a Bio-Gas Generator

## Material List (See diagrams below to help you)

- **200 liter metal drum** – It should have an attached lid with one big hole and one small hole, as well as both caps.
- **Inner tube** – It must be new. A car-sized inner tube is best. You must remove the interior valve. This will allow air to freely flow in and out of the inner tube.
- **Stove** – one-burner is sufficient. It is important to buy one with larger holes, as the bio-gas will be under considerably less pressure than bottled natural gas.
- **Gas Tubing** – You will need several meters of tubes to connect the inner tube to the drum and the stove. Measure the distances between your drum and stove, as well the distance between your drum and inner tube before buying the tubes. It is important that you purchase the correct amount of gas tubing.
- **Metal Parts:** Réduction 20/15, Mamelou, Vanne Papion, Manchon Chrome, Té Cuivre, 2 Pipes
- **4 Screw Connectors:** Will be used to secure gas tubing.
- **White Tape:** used to seal screw connections
- **Washers** : will be used to seal connections air tight
- **Screw Driver:** must be an appropriate size to fit the connectors that will close the hold the gas tube to the pipe
- **15 Liter Bucket:** This will be used to mix the water and manure together before charging the biogas generator.
- **Mineral Water Bottle:** The bottle must be empty and have the bottom cut off. This will act as a funnel to charge the bio-gas generator.
- **Plastic Goblet:** Used to charge the bio-gas generator.
- **5, 20 Liter jugs filled with water or 100L of water:** Will be mixed with manure and charged inside the drum
- **Animal Manure:** 3 market bags of chicken, cow, or pig manure. It can be fresh or dried.
- **4, 35 gram sachets of powdered soap:** Will be used to clean and remove any petrochemicals that may be left inside the drum.





## ***Before Beginning Construction of the Bio-gas System***

**Read instructions thoroughly.**

### **1. Decide where you would like to place the drum and inner tube.**

The drum must be placed **outside** and 15 meters away from any water source.

If a leak develops in the system, the gas will have no scent. Leaking gas can suffocate humans and animals, or cause an explosion if ignited. Be sure that the system is placed in an area away from children and animals.

The drum must not be moved after it is charged with manure. If the drum is moved, manure can become lodged in the tube which could restrict or block gas leaving the drum.

Don't forget that if it's very hot or very cold in your village, it will be difficult to make your bio-gas system produce bio-gas. The ideal temperature for bio-gas production is between 32 and 37 degrees Celsius. If the temperature is less than 15 degrees Celsius, almost no gas will be produced. If it's very hot in your village, you can place the drum in the shade of a tree. If it's very cold in your village, you can put the drum in the sun to maintain the temperature. You can also bury the drum halfway to three fourths of the way in the ground to help insulate it from the cold.

Place the inner tube close to the drum. It must also be **outside**. You can place the inner tube on top of the drum or hang it from your roof with string. This way it's blocked from the weather and out of children's reach.

### **2. Decide where the stove will be placed in the home.**

While the inner tube and the drum will be placed outside, the stove can be placed inside. It's easy to place a tube through a window connecting the stove to the drum. Another option is to make a small hole in your mud brick wall, put the tube through the hole, and then seal the wall with mud or cement.

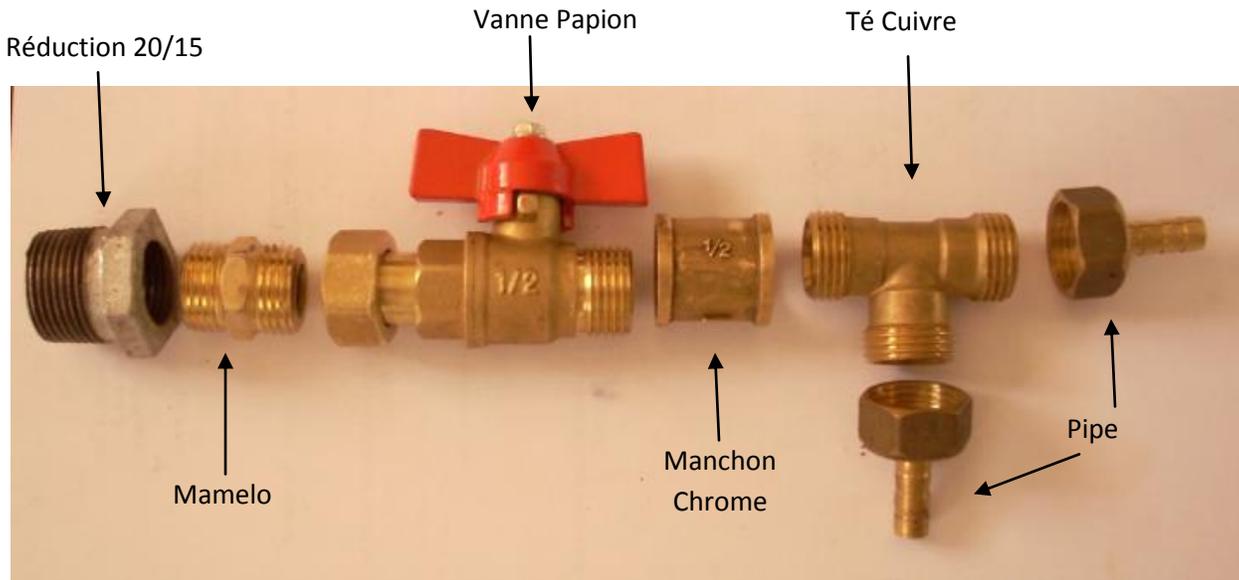
### **3. Determine the amount of tubing that is needed**

Measure the distance between the drum and the inner tube. Then, measure the distance between the drum and the stove. It is important to have this information in order to purchase the correct amount of gas tubing.

## Construction

Before beginning construction, review the materials listed to make sure that you have everything.

1. **Put the metal pieces together.** See the diagram below. Use washers and the white tape to connect all of the joints. This will insure all of the connections are secure, and your bio-gas system will not leak any gas.



2. **Connect the metal pieces to the drum.**

Use washers and white tape. Before filling the drum with manure, it's important that all the pieces fit together and are air tight. If there is a problem within the network of tubes, this will give you an opportunity to fix it, before your biogas digester is producing gas. Use the photos as a guide.



### 3. Cut the gas tubing into 2 pieces

Cut the gas tube into 2 appropriately sized pieces. One piece will be attached to the pipe on the drum and lead to the inner tube. The second will connect the second pipe on the drum to the stove.

## ***How to Charge the Bio-gas System***

### 1. Cleaning the drum

The drum has to be **very clean**. Any kind of petroleum products or chemicals will kill the bacteria that produce the bio-gas. If the drum contains petroleum or chemicals when you add the manure, **no gas** will be produced. If you're not sure if the drum is clean enough, smell it. Any chemical smells means that it needs to be cleaned.

Removing any petrochemicals from the drum is easy and inexpensive to do.

You will need:

- 4, 35 gram packets of OMO or other powdered soap.
  - 40 Liters of very hot or boiling water.
1. Add 2 packets of powdered soap and 10L of boiling water to the drum. Close both caps and roll the drum around on the ground for 5 minutes. This will ensure that the drum is being cleaned thoroughly. Remove the soap and water from the drum.
  2. Repeat step 1
  3. Add 20L of boiling water to the empty drum. Close both caps and roll around the drum on ground for 3 minutes. Remove the water from drum.

4. Your drum should now be fully cleaned and ready to use. Verify that it is clean by smelling the inside. If you smell any kind of petrochemical smell the drum must be cleaned again. Repeat step 1. Then rinse with 10L very hot water for 3 minutes. The drum will now be ready to use.

## 2. Charge the drum

Put an equal amount of manure and water in a bucket. Using a stick, mix the manure and water together **very well**.

Cut off the bottom of a plastic mineral water bottle to create a funnel. Use the goblet and the funnel to fill the drum with the manure and water mixture.

Continue to fill the drum with water and manure. Leave an empty space approximately the length of your hand at the top of the drum. This will help ensure that if the bio-gas generator gets bumped or moved, the tube won't become blocked with manure.

## 3. Connect the tubing

Clean the holes in the drum with a leaf or paper tissue. Connect the valve to the drum and close the large hole. Be sure to use the white tape to ensure an air tight seal.

## 4. Open the valve on the drum.

Once everything is connected and the drum is charged, be sure that the valve (Vanne Papion) on the drum is open and the stove is off. Your bio-gas generator is now ready and producing gas.

## 5. Wash your hands thoroughly with soap and water.

If you have manure on your hands while you are eating, you can get amoebas, dysentery, worms, or other terrible illnesses. It's very important to wash your hands with soap and water immediately after you have finished.

## ***Gas Production***

After the bio-gas system is charged, it will start to produce gas. It can take up to 3 weeks before gas production begins depending on conditions. The inner tube will inflate as gas is produced.

There are a number of factors that affect gas production:

### 1. Outside Temperature

- a. Cold environments will slow gas production, while warm environments will encourage gas production.
- b. As the outside temperature fluctuates, the inner tube might expand in the heat and contract in cool temperatures. This is normal.

### 2. Type of Manure

- a. Fresh manure will produce gas much quicker than dry manure, though the gas may not last as long.

If the bio-gas generator is constructed properly, it will have continuous gas production for 2.5 to 3 months. Once gas production slows considerably or ceases, the bio-gas system simply needs to be recharged. After it's recharged with new manure, the bio-gas stove will produce gas again. The old manure can be used as green fertilizer. **Nothing is wasted!**

### ***Before lighting for the first time***

There could be oxygen in the inner tube left over from constructing the generator. If you light the stove and there is oxygen inside the drum or tubes, there is a risk that the flame could travel inside, causing a large explosion.

Before lighting for the first time, it is **very important** to release the gas inside the inner tube. You can do this by opening the valve on the stove and letting out the gas. Lightly press on the inner tube until all of the gas is out. Be careful not to breathe in this gas. Once all the gas has been removed, close the valve on the stove.

The inner tube will fill up again. Release the gas a second time to make sure that all of the oxygen has been removed. When the tube is filled with gas a 3<sup>rd</sup> time, you can begin using it.

### ***Recharging the biogas system***

Once the bio gas stove stops producing gas it will need to be recharged.

Close the valve on the drum (Vanne Papion) and unscrew the lid on the drum. When the drum is open, remove most of the old mixture of manure and water. **Leave 5 to 10 liters of the old mixture in the drum.**

**Note:** The reason that the stove takes several weeks to start producing gas is because it takes time for the small number of bacteria to multiply into sufficient enough numbers to produce large quantities of methane gas. Leaving some of the old mixture behind will help your bio-gas system to begin producing gas more quickly.

Recharge the drum using the same procedures as before.

Before lighting remove the gas **one time**. Use the same procedures as before.

Your bio gas is now recharged and ready to use.

### ***Maintaining the biogas system***

The bio gas generator will only need maintenance if a component becomes broken or damaged. Simply replace the component that becomes broken or damaged.

If the bio-gas generator is kept away from strong winds, rain, dust, storms, and children, you should have very few problems.

## Trouble Shooting

If the bio-gas generator is not producing any gas, it is possible that:

- Manure and water was not mixed well enough
  - Remove the mixture of manure and water. Mix it thoroughly in a bucket and refill the drum. Remove the bio-gas from the filled inner tube several times, before lighting.
- Outside temperature is too cold
  - Try burying the drum in the ground in order to maintain a more constant temperature.
- Leak has developed in the biogas generator
  - Take a bar of soap and some water. Create a lather in your hand and rub the mixture along the system of tubes. Leaks will be indicated by streams of air bubbles. Once a leak has been indentified, repair it using appropriate measures.