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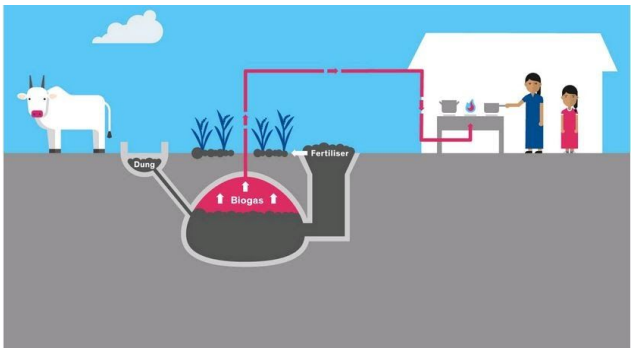
Biogas Systems

Recycling organic waste for clean cooking energy , fertiliser , and Biogas Generator.

Objective

The overall objective of this climate protection programme is the installation of domestic biodigesters as a clean, sustainable energy source throughout VANUATU. The biogas generated from cow dung replaces fuels that are currently used for domestic energy needs such as firewood or kerosene.

The programme results in greenhouse gas (GHG) emission savings in the following ways: The biogas displaces GHG emissions from kerosene and fuel wood that used to be used for cooking. The biogas produced from cattle manure is a renewable source of energy. The biogas displaces GHG emissions from cattle manure that is currently dumped in pits near the household. The cattle manure is dumped along with other waste such as straw from the cow shed, some kitchen waste, crop residues and other organic matter and liquids in the pit. This organic waste is never dry and does not get mixed therefore animal waste is decaying anaerobically and emitting methane.



What is a biogas system?

A biogas system relies on the natural interaction between microorganisms and organic wastes – such as manure, sewage, agricultural by-products, and discarded food – to produce a clean and energy-efficient burnable gas. The

gas is distributed through a network of pipes and is used for cooking and heating. This is done in the same way that many of us use natural gas from our local utility provider. With the simple strike of a match and turn of a knob, a family has a safe gas stove courtesy of their friendly neighbourhood microorganisms.

The key difference between natural gas and biogas is that biogas is a renewable source. This means that the system can continue running as long as there is organic waste being added. In comparison, natural gas comes from gas deposits underground, and once used, is gone. Another important difference is that biogas also produces a secondary benefit that natural gas cannot: the creation of free, methane-rich fertiliser as a natural by-product. This can either be sold to make an income or used on farm land to improve crop yields.

Finally, biogas systems can save lives and improve the overall health of households. Because of its efficiency, biogas puts off minimal emissions. This means there is no indoor air pollution or smoke. In comparison, other popular cooking and heating sources in rural communities such as firewood, kerosene, paraffin, and dried animal waste can produce extremely harmful emissions. These emissions, in addition to contributing to climate change, can ultimately lead to serious health complications and premature deaths within families.

Where is a biogas system appropriate?

Biogas systems are appropriate in remote areas that lack commercial energy sources – such as an electricity or natural gas utility providers. They can also be wonderful supplemental energy sources, limiting the amount of commercial electricity consumed. They are most effective in areas where people depend on traditional energy – such as firewood, kerosene, paraffin, or dried animal waste – for their cooking and heating needs. Biogas systems are well suited for areas with large quantities of organic waste, such as communities with livelihoods centred around farming and raising livestock. Biogas systems are also appropriate in urban and semi-urban areas to generate energy from municipal solid waste (i.e. sewage).

Size of plant in cubic metres	Cooking fuel is sufficient for (in no. of people)	Quantity of cattle dung required daily in kg	No. of cattle heads required
1	2	25	2 to 3
2	4	50	4 to 6
3	6	75	7 to 9
4	8	100	10 to 12

Overview

Diagram Description:

A biogas system comes in many shapes and sizes; however, it always relies on the same basic principle: harnessing the power of microorganisms through a natural process called anaerobic digestion.

- Organic materials are collected from a system of inlet pipes and are then sent to the digester, where it is collected and left for microorganisms to feed on.
- The central element of any biogas system is the digester. This digester is where the breakdown of organic waste is done by microorganisms. It is also where the biogas is produced and stored. The digester is constructed so that there is an absence of oxygen, which allows for anaerobic digestion to take place.
- Over time, the organic waste is broken down in the digester by the microorganisms. This breakdown process involves the microorganisms emitting methane gas and carbon dioxide.
- The methane gas and carbon dioxide is stored in the concrete gas dome. The resulting mix of gases can then be collected and burned as fuel – i.e. biogas.
- The biogas is distributed to homes via gas outlet pipes originating from the gas dome. Inside homes, families have a gas line with a knob to turn the gas on and off on-demand.
- Lastly, after the organic waste has been broken down by the microorganisms, the by-product is pushed out through a different outlet pipe as a rich and productive fertiliser. This fertiliser is stored and can be used by families for agriculture as they need it.

Useful Resources

Average maximum biogas production from different feed stocks

Sl. No.	Feed Stock	Litre /kg of dry matter	% Methane content
1.	Dung	350*	60
2.	Night-soil	400	65
3.	Poultry manure	440	65
4.	Dry leaf	450	44
5.	Sugar cane Trash	750	45
6.	Maize straw	800	46
7.	Straw Powder	930	46

Equivalent quantity of fuel for 1 m^3 of biogas

Name of the fuel	Kerosene	Fire-wood	Cowdung cakes	Charcoal	Soft coke	Butane	Furnace Oil	Coal gas	Electricity
Equivalent quantities to 1 m3 of Bio-gas	0.620	3.474 kg	12.296 kg	1.458 kg	1.605 kg	0.433 kg	0.4171	1.177 m3	4.698 kWh

Biogas Requirements

Sl. No.	Use	Quantity requirement
1.	Cooking	336 - 430 1/ day / person
2.	Gas Stove	330 1/ hr /5 cm burner
		470 1/hr/10 cm burner
		640 1/hr/15 cm burner
3.	Burner Gas Lamp	126 1/lamp of lighting equivalent to 100 watt filament lamp.
		70 1/hr/1 mantle lamp
		140 1/hr/2 mantle lamp
		1691/lir/3 mantle lamp
4.	Dual fuel engine	425 1/hp/hr

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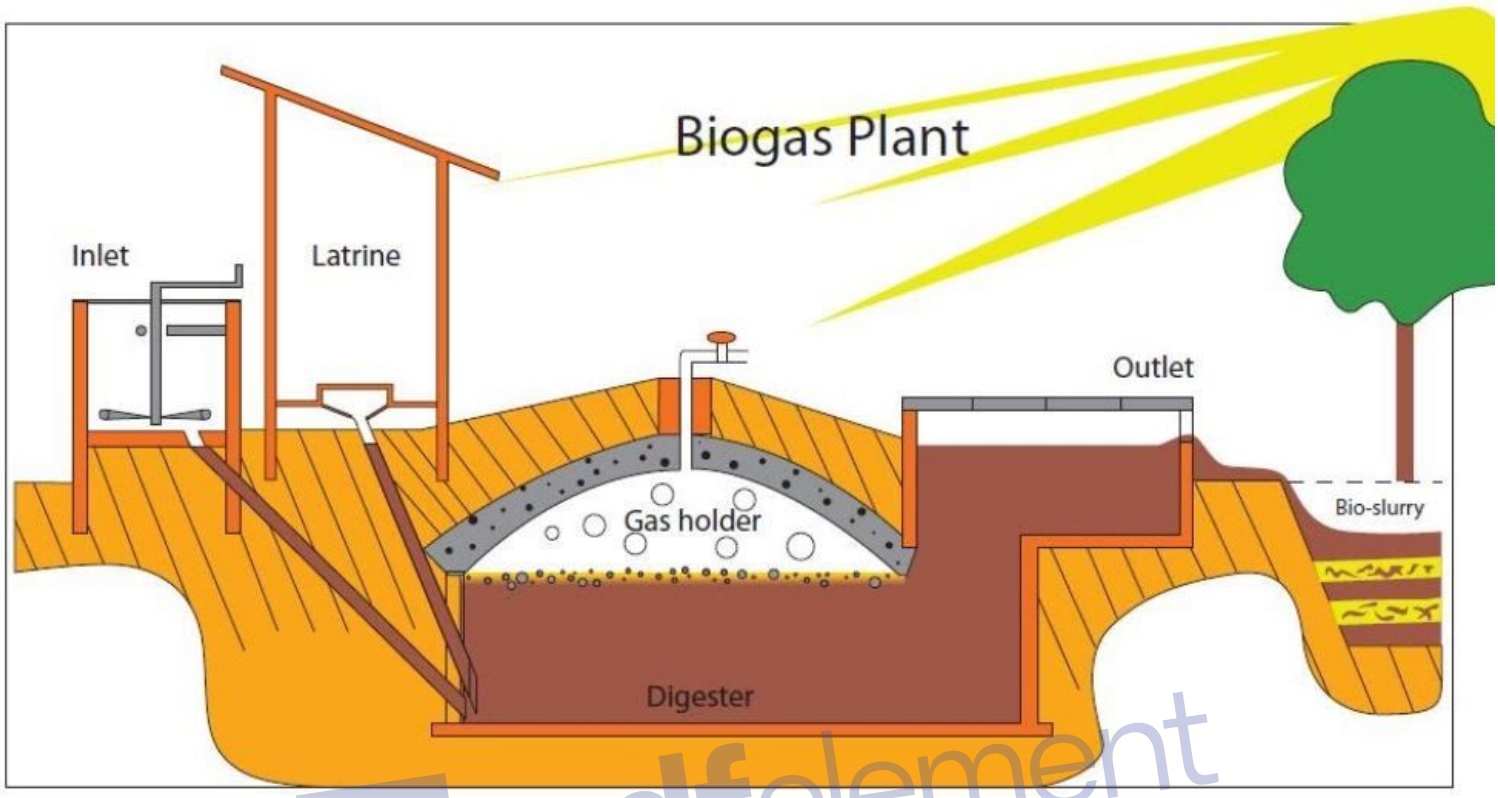
Calorific values of commonly used fuels

Commonly used fuels	Calorific values in Kilo calories	Thermal efficiency
Bio-gas	4713/M^3	60%
Dung cake	2093/Kg	11%
Firewood	4978/Kg	17.3%
Diesel (HSD)	10550/Kg	66%
Kerosene	10850/Kg	50%
Petrol	11100/Kg	---

Average dung yield

Sl. No.	Living Beings	Quantity of Dung / Night Soil produced (kg/day)
1.	Cow, Heifer	10.0
2.	Bullock	14.0
3.	Buffalo	15.0
4.	Young bovine	5.0
5.	Horse	14.0
6.	Horse, young	6.0
7.	Pigs, over 8 score	2.5
8.	Pigs, under 8 score	1.0
9.	Ewes, rams and goats	1.0
11.	Lambs	0.5
12.	Duck	0.1
13.	10 hens	0.4
14.	Human beings	0.4

Note :For free grazing animals the availability of dung may be taken as 50 per cent of the amount given in the table



This project contributes to 11 SDGs

I. The use of slurry (organic fertiliser produced by the farmers themselves) helps to prevent small farmers from becoming dependent on chemical fertilisers, thus improving their families' financial situation.

II. Because the time-consuming collection of firewood is no longer necessary, children have more time to go to school and do homework. This gives each family almost 3 hours of additional time per day.

III. Only women are entitled to buy and own a biogas plant. This helps to level out the balance of power in the family and to strengthen the position of the women.

IV. 1.000 biogas digesters will be installed in 2020..

V. The recycling of organic waste contributes to sustainable waste management.

VI. Each biogas bio digester avoids 2.2 t CO_2 and reduced wood consumption by 5.4 t per year.

VII. , The programme will reduce wood consumption by 80,000 tons and will save 300 hectares of forest from deforestation.

VIII. The programme enables the transfer, dissemination and implementation of environmentally friendly technologies in Vanuatu.

The **biogas** comes to be a combustible gas that is generated in specific devices, or in natural media from the different reactions of biodegradation suffered by **organic matter** , through the action of **microorganisms** as well as of other factors in the absence of air.

This resulting gas consists of a **29% carbon dioxide (CO2), 60% methane (CH4)** , and other gases although in smaller quantities than the previous ones. The main one is **methane** , and it is this gas that serves as fuel.

It occurs because the microorganisms we talked about earlier , anaerobic bacteria, mainly, can feed on organic matter, and the product of their digestion are these gases that we discussed earlier. All this is done in the absence of oxygen.

The organic matter we are talking about may be debris of agriculture, manure, municipal waste, food waste, vegetables, etc. Biodegradable materials, which can ferment after the action of bacteria.

What can biogas be used for?

The production of biogas by decomposition without air (decomposition) anaerobic) is a useful way to treat biodegradable waste, since it produces a valuable fuel (methane), and generates a waste that can be applied as a generic fertilizer or soil conditioner.

This type of gas can also be used to produce electrical energy by means of turbines or gas generating plants, as well as stoves, dryers, furnaces, boilers or other gas combustion systems.

Methane can be compressed in the same way as gas natural that we use to warm up. This can be used in the engines of cars, like the CNG. In countries like Sweden, Switzerland and Germany, it is widely used in public transport, and also in private transport.

Advantages of biogas production

- It is a eco-friendly fuel.
- The required raw materials for biogas production are available abundantly in villages.
- It not only produces biogas, but also gives us nutrient rich slurry that can be used for crop production.
- It prevents the health hazards of smoke in poorly ventilated rural households that use dung cake and fire-wood for cooking.
- It helps to keep the environment clean, as there would be no open heap of dung or other waste materials that attract flies, insects and infections
- Availability of biogas would reduce the use of firewood and hence trees could be saved.

Components of biogas plants

- **Mixing tank** - The feed material (dung) is collected in the mixing tank. Sufficient water is added and the material is thoroughly mixed till a homogeneous slurry is formed.
- **Inlet pipe** - The substrate is discharged into the digester through the inlet pipe/tank.
- **Digester** - The slurry is fermented inside the digester and biogas is produced through bacterial action.
- **Gas holder or gas storage dome** - The biogas gets collected in the gas holder, which holds the gas until the time of consumption.
- **Outlet pipe -** The digested slurry is discharged into the outlet tank either through the outlet pipe or the opening provided in the digester.
- **Gas pipeline -** The gas pipeline carries the gas to the point of utilization, such as a stove or lamp.

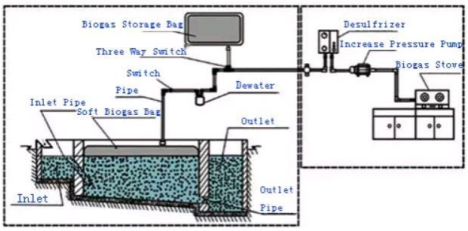
Points to be considered for construction of a biogas plant

Site selection

While selecting a site for a biogas plant, following aspects should be considered

- The land should be levelled and at a higher elevation than the surroundings to avoid water stagnation

- Soil should not be too loose and should have a bearing strength of 2 kg/cm^2
- It should be nearer to the intended place of gas use (eg. home or farm).
- It should also be nearer to the cattle shed/ stable for easy handling of raw materials.



Biogas System

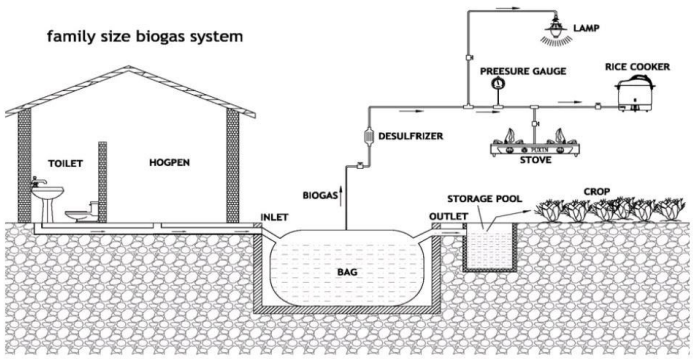
- The water table should not be very high.
- Adequate supply of water should be there at the plant site. The plant should get clear sunshine during most part of the day.
- The plant site should be well ventilated.
- A minimum distance of 1.5m should be kept between the plant and any wall or foundation.
- It should be away from any tree to prevent root interference.
- It should be at least 15m away from any well used for drinking water purpose.

Availability of raw materials

The size of the biogas plant is to be decided based on availability of raw material. It is generally said that, average cattle yield is about 10 kg dung per day. For eg. the average gas production from dung may be taken as 40 lit/kg. of fresh dung. The total dung required for production of 3 m^3 biogas is 3/0.04= 75 kgs. Hence, a minimum of 4 cattle is required to generate the required quantity of cow dung.

Technical guidelines for establishment of Biogas plants

i. Digester Design



- The recommendation of KVIC is to have a digester volume of 2.75 times the volume of gas produced per day.
- KVIC recommendation for the depth of the plant is between 4 to 6 m according to the size but for economical use of building materials, a depth to diameter ratio between 1.0 to 1.3 are considered ideal for all types of plants. In a floating drum plant, a continuous ledge is built into the digester at a depth 10 cm. shorter than the height of the gas drum to prevent the gas holder from going down when no gas is left in it. It helps in preventing the gas inlet being choked. It also guides the gas bubbles rising from the side of the plants into the gas bolder.
- In some plants slurry is fed at the bottom and removed at the top. When the digester diameter exceeds 1.6 m, a partition wall is provided in the digester to prevent short circuiting of slurry flow and increasing its retention period. In case of fixed dome plants, the volume of digester comes to between 1.5 times to 2.75 times the gas produced per day. Here, the higher the plant capacity, the lesser becomes the ratio of digester volume to gas produced per day.

ii. Gas Holder Design

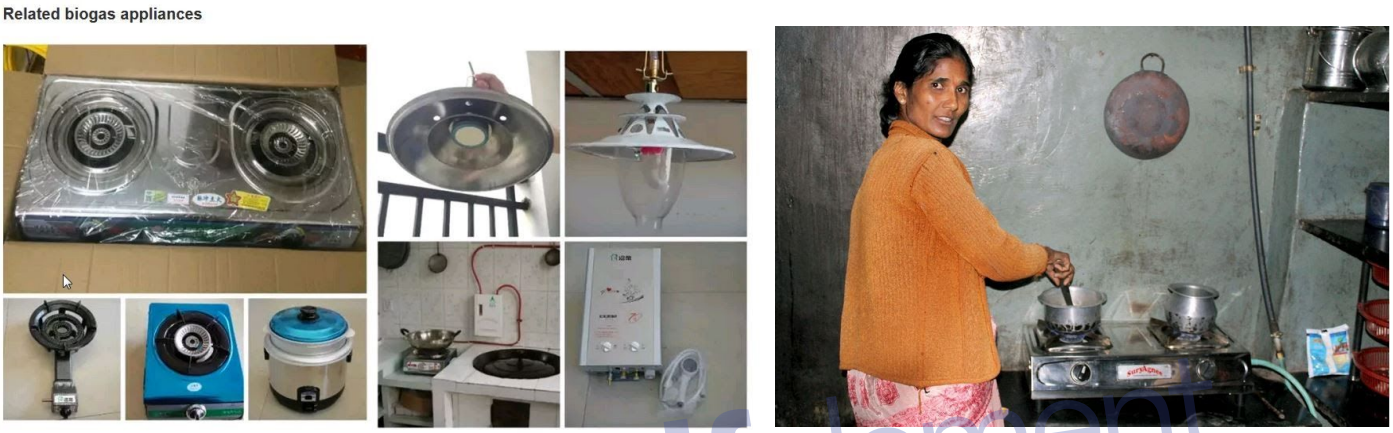
- The design of a gas holder is influenced by the digester diameter and distribution of gas use during the day. For domestic plants, the gas holder capacity is kept at 60 per cent of a day's gas production and in case of laboratories, it is kept at 70 per cent of the day's gas production.
- In a floating drum plant, the gas holder diameter is 15 cm. less than the diameter of the digester and accordingly the other dimensions are decided. The gas holder can be given a rotary movement around its guide to break the scum formation at the top.
- In a fixed dome plant the dome angle is kept between 17° and 21° and it gives a pressure upto 100 cm. of water. Due to higher pressure, the diameter of gas pipelines can be reduced and the gas can be taken to greater distance. In this plant, care should be taken to provide an earth pressure equivalent to 100 cm of water column from the top of the dome. Always use *'A'* class bricks in the domes for better stability.

iii. Inlet Tank

- Before the dung is fed into the plant, it is mixed with water in a tank to give a solid content of 7.5 per cent to 10 per cent in the slurry. This tank also helps in removing grass and other floating materials from the raw materials to prevent excessive scum formation in the plant. This tank is connected to the digester by an asbestos cement pipe. The floor of the mixing tank is given a slope opposite to the direction of inlet pipe to help heavy inorganic solid particles to settle and get separated from the slurry.
- **Performance** :
- About 5 kg of waste is required for a 1 cubic metre plant which is equal to 0.43 kg of LPG. It is estimated that 100 cubic metres of biogas could produce 5 KW of energy to meet a 20-hour power requirement of a house The process is hygienic and is devoid

of odour and flies. The unit also helps in controlling climate change effects and arrests green house gases, and the digested outlet slurry of the unit acts as good organic manure

Kitchen Waste Based Biogas Plant



A kitchen waste based biogas plant will be installed at FRESWOTA SCHOOL Port Vila site for environmental friendly disposal of the waste generated in kitchens of various canteens premises. It is expected that the plant can process all the waste generated in these canteens.

The biogas plant has following components:

- A mixer/pulper (5 HP motor) for crushing the solid waste
- Premix tanks
- Pre digester tank
- Main digestion tank (35 m^3)
- Manure pits
- Gas lamps for utilisation of the biogas generated in the plant.

Process: The waste generated in kitchen in the form of vegetable refuge, stale cooked and uncooked food, extracted tea powder, waste milk and milk products can all be processed in this plant.

Precautions may be taken while collecting the kitchen waste :

- A separate container for coconut shells, coir, egg shells, onion peels and bones. These will not be processed in the biogas plant.

- Separate containers of small volumes (5 litre capacity) to collect the wet waste (spoilt or stale cooked food, waste milk products etc.). The vegetables refuse like peels of various vegetables, rotten potatoes, and tomatoes, coriander leaves etc. may be collected in garbage bags of 5-kilo capacity. It must be noted that such segregation is of utmost importance for smooth running of the biogas plant.

There are two important modifications made in the conventional design of the biogas plant :

- Introduction of a 5 HP mixer to process the waste before putting it into pre digestor tank. The waste is converted in slurry by mixing with water (1:1) in this mixture.
- Use of thermophilic microbes for faster degradation of the waste. The thermophiles can thrive superbly at high temperatures. Since the environment for such micro-organisms sustains higher temperatures, many spoilage and pathogenic organisms cannot survive in such extreme conditions. Therefore it would be ideal if we can make use of these organisms to degrade the kitchen waste to remove more toxic elements and then subject it to the traditional biogas plant for methane generation.

A high temperature is maintained in the pre digestor tank. The growth of thermophiles in the pre digestor tank is assured by mixing the waste with hot water and maintaining the temperature in the range of 55-60ºC. The hot water supply is from a solar heater. Even one-hour sunlight is sufficient per day to meet the needs of hot water.

Another important aspect in smoother running of a biogas plant based on solid waste is how effectively one can avoid the choking of the plant. This choking may occur due to thick biomass that may be inaccessible to the micro-organisms to digest it. The logical solution to such a problem is to convert the solid waste into slurry that would be far more accessible for the microbial action. A high power mixer to convert the solid waste into slurry can achieve this purpose.

After the pre digestor tank, the slurry enters the main tank where it undergoes mainly anaerobic degradation by a consortium of archaebacteria belonging to Methanococcus group. These bacteria are naturally present in the alimentary canal of ruminant animals (cattle). They produce mainly methane from the cellulosic materials in the slurry.

The undigested lignocellulosic and hemicellulosic materials then are passed on in the settling tank. After about a month high quality manure can be dug out from the settling tanks. There is no odour to the manure at all. The organic contents are high and this can improve the quality of humus in soil, which in turn is responsible for the fertility.

As the gas is generated in the main tank, the dome is slowly lifted up. It reaches a maximum height of 8 feet holding 35 m^3 of gas. This gas is a mixture of methane (70-75%), carbon-di-oxide (10-15%) and water vapours (5-10%). It is taken through GI pipeline to the lamp posts. Drains for condensed water vapour are provided on line. This gas burns with a blue flame and can be used for cooking as well. The gas generated in this plant is used for gas lights fitted around the plant. The potential use of this gas would be for a canteen. The manure generated is high quality and can be used in fields.

Success of this biogas plant depends a great deal on proper segregation of the kitchen waste. The materials that can pose problems to the efficient running of plant are coconut shells and coir, egg shells, onion peels, bones and plastic pieces. Steel utensils like dishes, spoons etc. are likely to appear in the waste bags from canteens. While bones, shells and utensils can spoil the mixer physically, onion peels, coir and plastic can have detrimental effects on microbial consortium in the predigester and main digestion tanks which could be disastrous for the plant.

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ASSEMBLY TYPE DIGESTER

Image				
Model	**ES-3m3**	**ES-5m3**	**ES-10m3**	**ES-15m3**
Dimension (cm)	162*132*176	194*194*181	388*194*181	582*194*181
Fermentation capacity (m3)	1.3	2.4	4.8	7.2
Max. Daily gas production (m3)	2.4	4	8	12
Max. Biogas storage capacity (m3)	2.2	3	6	9
Shipping Package volume (m3)	0.4	0.45	0.68	0.8
Waste feed (kg/day) half is water	43	80	160	240

Image				
Model	**ES-50m3**	**ES-60m3**	**ES-120m3**	**ES-600m3**
Dimension (cm)	388*970*181	582*776*181	1164*776*181	3417*970*181
Fermetation capacity (m3)	24	29	57	288
Max. Daily gas production (m3)	44	52	96	480
Max. Biogas storage (m3)	30	32	64	320
Packing volume (m3)	3.5	4.5	6	18
Waste feed (kg/day) half is water	900	960	1920	9600
Material of the digester bag	Polymer polyester fiber membrane imported from Germany, specially developed for anaerobic digester that is corrosion-resistant&anti-UV and anti-aging).			
Material of the frame	Specially manufactured of high quality aluminum alloy which is light weight and high strength.			

Material of the sunlight PC board	Imported sunlight PC board, the outer wall is thickened with anti-UV and anti-aging coating, which is very strong and durable.
Material for inlet	Specially manufactured inlet, have the concave-convex groove inside, which can effectively sealing the odor inside of the digester
Material of screw fittings	All of the fittings are made of stainless steel, Strong and anti- rust.
Lifespan	At least 15years
Warranty	5 years
More size of the digester can be customized according to the situations of your project, the digester can be scaled up to any larger size based on 5m3	

DIYBIOGAS RED-MUD TYPE DIGESTER

Image				
	    			
Model	**ESRM-3m3**	**ESRM-5m3**	**ESRM-10m3**	**ESRM-50m3**
Dimension (cm)	2*1*1.5	2.5*1*2	4*1*2.5	10*2*2.5
Fermentation capacity (m3)	2.4	3.8	8	40
Max. Daily gas production (m3)	1.5	3	6	30
Packing volume (m3)	0.15	0.2	0.3	0.5
Waste feed (kg/day) half is water	60	90	200	1000
Thickness of the membrane (mm)	1.0	1.0	1.2	1.2
HS Code	39232900		39232900	

More larger size and various shape of the red-mud digester can be customized according to the situation of your project.

DIYBIOGAS RED-MUD STORAGE BAG

Image				
	    			
Model	**ESB-0.5m3**	**ESB-1m3**	**ESB-2m3**	**ESB-5m3**
Dimension (cm)	1*0.7*0.7	1*0.9*0.9	2*1*1	2.5*2*1
Packing volume (m3)	0.06	0.08	0.1	0.2
Thickness of the membrane(mm)	1.0	1.0	1.0	1.0
HS Code	39232900			

Model	ESB-10m3	ESB-20m3	ESB-50m3	ESB-100m3
Dimension (cm)	5*1*2	5*2*2	6*3*2.78	10*3.3*3
Packing volume (m3)	0.3	0.45	0.55	1
Thickness of the membrane(mm)	1.2	1.2	1.2	1.2
HS Code	39232900			
More larger size and various shape of the red-mud biogas storage bag can be customized according to the situation of your project.				

DIYBIOGAS GAS STOVE

Image				
Model	**ES-1B**	**ES-2B**	**ES-HB**	
Gas entrance pressure (Pa)	1600Pa~6000Pa	1600Pa~6000Pa	500Pa~5000Pa	
Heat power (KW)	1.75	3.25	3.26	
Gas consumption rate (m3/h)	0.28	0.35	0.45	
Ignition type	Pulse	Pulse	Pulse	
Size (cm) / Weight (kg)	37*30*12 / 3.1	71*37*13 / 5.3	51*28*13 / 5	
HS Code	73211100			

DIYBIOGAS GAS PUMP

Image				
Model	**ES-20w**	**ES-12w (AC/DC)**	**ES-40w**	**ES-100w**
Voltage (v) / Power (W)	220 / 20	220 /12	220 / 40	220 / 100
Frequency (Hz)	50	50	50	50
Flow	≥ 39 ~ 41L/min or 2.4 M³/ H	≥ 24L/min or 1.5 M³/ H	70L/min or 4.2 M³/ H	90L/min or 5.4 M³/ H
Weight (kg)	1.42	3.5	3	5

Image		
Model	**ES-P120**	**ES-P250**
Voltage / Power	220v / 120w	220v / 250w
Flow rate	190L / min or 11.4 M³/ H	440 L / min or 26.5 M³/ H

Max Gas pressure	10kpa	11kpa
Gas inlet pipe inner diameter (mm)	30mm	30mm
Gas outlet pipe inner diameter (mm)	25mm	30mm
Weight (kg)	15kg	16kg
HS Code	8414809090	

DIYBIOGAS SLURRY PUMP

Model	ES-220V-1100W	ES-220V-1500W	ES-220V-2200W	
Voltage	220	220	220	
Rated power(kw)	1.1	1.5	2.2	
Rated head (m)	10	15	20	
Rated flow (m3/h)	15	15	15	
Gas outlet pipe outer diameter (mm)	50	50	50	
Material	Stainless steel	Stainless steel	Stainless steel	
Model	**ES-380V-3000W**	**ES-380V-5500W**	**ES-380V-7500W**	
Voltage	380	380	380	
Rated power(kw)	3	5.5	7.5	
Rated head (m)	25	15	15	
Rated flow (m3/h)	15	65	100	
Gas outlet pipe outer diameter (mm)	50	80	80	
Material	Stainless steel	Stainless steel	Stainless steel	
HS Code	8413709190			

DIYBIOGAS DESULFURIZER AND DEHYDRATOR

Desulfurizer

Image				
Model	**ES-1L**	**ES-2L**	**ES-10L**	**ES-25L**
flow rate (m3/day)	≤5	≤10	≤25	≤ 50
Treatment of biogas (m3)	150	300	750	750

Material	plastic	plastic	plastic	plastic
HS Code	84213990			

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Model	ES-50L	ES-100L	ES-200L	
Dimension (cm)	Φ273*750	Φ400*1000	Φ400*1000	
flow rate (m3/day)	≤100	≤150	≤300	
Treatment of biogas (m3)	3000	6000	12000	
Material	Stainless steel	Stainless steel	Stainless steel	
HS Code	7310100090			

Dehydrator

Model	ESW-50L	ESW-100L	ESW-200L	
Dimension (cm)	Φ273*750	Φ400*1000	Φ400*1000	
flow rate (m3/day)	≤100	≤150	≤300	
Treatment of biogas (m3)	3000	6000	12000	
Material	Stainless steel	Stainless steel	Stainless steel	
HS Code	7310100090			

DIYBIOGAS FLOW METER

Biogas flow meter

Image				
Model	**ES-G2.5**	**ES-G4**	**ES-G6**	**ES-G10**
Dimension (cm) / Weight (kg)	17*13*23 / 2	21*18*23 / 2.5	25*20*26 / 3.1	29*22*21 / 4.3
Max. flow rate Qmax (m^3/h)	4	6	10	16
Min. flow rate Qmin (m^3/h)	0.025	0.04	0.06	0.1
Material	Aluminum shell	Aluminum shell	Aluminum shell	Aluminum shell
HS Code	90268000			

Ultrasonic biogas flow meter

Specification		Model		Image
Measurement accuracy ((FS))	CH4≤ 5 % (FS)			

The flow measurement range	0 ~ 4 m³/h	**ES-BF2002**		
The Working pressure (Kpa)	< 100 Kpa			
Power Supply	AA battery			
Connection	M30*2.0 mm			
HS Code	90268000			

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DIYBIOGAS SOLID LIQUID SEPARATOR

Specification		Model		Image
Motor power (kw) / Voltage (v)	4kw / 380v	ES-180		
The host power （kw）	5.5kw			
Working capacity (m3/h)	10m³/h			
Size L*W*H (cm)	210*70*140			
Package weight (kg)	450kg			
Capacity per hour （m3）	8-15			

Specification		Model		Image
Motor power (kw) / Voltage (v)	4kw / 380v	ES-200		
The host power （kw）	7.5kw			
Working capacity (m3/h)	15m³/h			
Size L*W*H (cm)	210*70*140			
Package weight (kg)	450kg			
Capacity per hour （m3）	8-15			
HS Code	8421192000			

SOLID LIQUID SEPARATOR

CH4 / CO2 / H2S, 3 in 1 analyser

Specification		Model		Image
Gas Detected	CH4 / CO2 / H2S	ES-GASD2000		
Detection Range	CH4 : (0-100)%vol			
	CO2 : (0-100)%vol			
	H2S : (0-1000)ppm			
Operating Temperature	-25°C~+55°C			

Battery (Chargeable)	PL123450, 3.7V/1500mA			
Display	LCD display with backlight			
Degree of Protection	IP65			
Dimensions (mm)/ Weight(g)	130*66*30 / 230			
HS Code	902680900			

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H2S detector

Specification		Model		Image
Gas Detected	H2S	ES-GASD		
Detection Range	H2S : (0-2000)ppm			
Operating Temperature	-25°C~+55°C			
Battery (Chargeable)	PL123450, 3.7V/1500mA			
Display	LCD display with backlight			
Degree of Protection	IP65			
Dimensions(mm) / Weight(g)	130*66*30 / 230			
HS Code	902680900			

APPLIANCES

Image				
Model	**Biogas lamp**	**Biogas room heater**	**Water heater (7L)**	**Biogas rice cooker**
Gas consumption (m3/h)	0.07m3/h	0.4m3/h	2-3m3/h	0.3m3/h
HS Code	94055000	94055000	84191100	73211100

Image				

Model	Pressure gauge	0.6L Deshydrater	Biogas soft pipe with connector (30 meter of Φ 10mm)	Biogas pipe with connector (30 meter of Φ 16mm)
HS Code	9026209090	39174000	39173300	39173300

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BIOGAS GENERATOR （Small)				
Image				
Model	**ES-1.5KW**	**ES-3.5KW**	**ES-5.5KW**	**ES-6.5KW**
Gas Source	Biogas	Biogas	Biogas	Biogas
Rated Power(kw)	1.0kw	3.0kw	4.0kw	6.0kw
Max Power(kw)	1.5kw	3.5kw	5.0kw	6.5kw
Rated Voltage / Frequency (v/Hz)	220v / 50Hz	220v / 50Hz	380(220)v / 50Hz	380(220)v / 50Hz
Power Factor	Cos1.0	Cos1.0	Cos1.0	Cos1.0
Noise(7m)（db)	61	65	65	75
Continuous working time (h)	9h	9h	9h	9h
Gas Consumption(m3/kw.h)	0.84M3/H	1.46M3/H	3.63M3/H	3.76M3/H
Package(mm) / GW(kg)	490x425x430 / 48	490x425x430 / 48	670x515x535 / 92	670x515x535 / 92
HS Code	8502200000		8502200000	

BIOGAS GENERATOR （Medium and large）				
Image				
Model	**ES-G10KW**	**ES-G20KW**	**ES-G50KW**	**ES-G100KW**
Power (kw)	10	20	50	100
Speed (rpm)	1500	1500	1500	1500
Current (A)	18	36	90	180
Cooling method	Closed water cooled	Closed water cooled	Closed water cooled	Closed water cooled

Start method	Electric	Electric	Electric	Electric
Single machine capacity (kw)	15	22	58	132
Dimension (L*W*H) (mm)	1450*700*1100	1650*720*1250	2100*770*1300	2650*1100*1900
Weight (kg)	470	620	1250	2560

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BIOGAS GENERATOR （large）

Model	ES-G150KW	ES-G200KW	ES-G250KW	ES-G500KW
Power (kw)	150	200	250	500
Speed (rpm)	1500	1500	1500	1500
Current (A)	270	361	450	900
Cooling method	Closed water cooled	Closed water cooled	Closed water cooled	Closed water cooled
Start method	Electric	Electric	Electric	Electric
Single machine capacity (kw)	170	230	280	550
Dimension (L*W*H) (mm)	2850*1650*1800	2850*1650*2200	3300*1650*2780	5820*2040*2780
Weight (kg)	3200	3300	3500	12000
HS Code	8502200000			