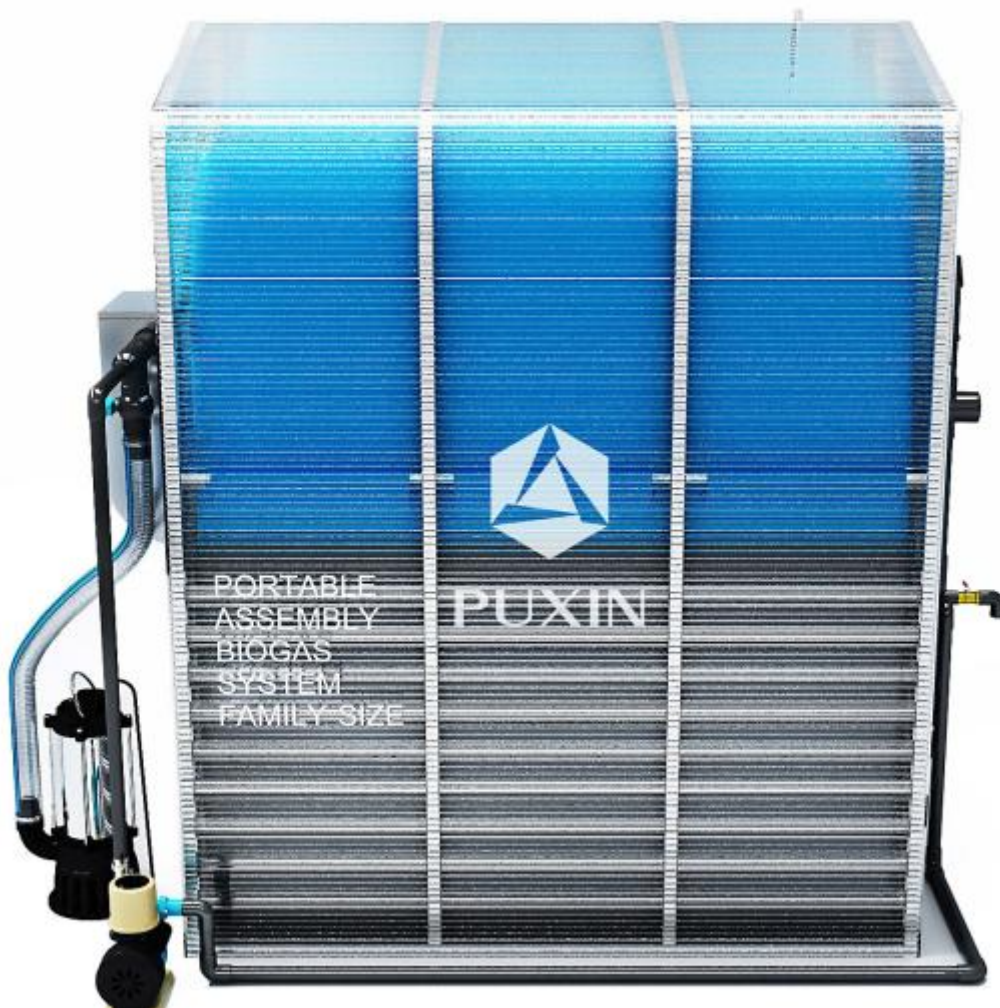

Shenzhen Puxin Technology Co. Ltd

Operation Manual
Of PUXIN Portable Biogas Plant





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Part One: The basic knowledge about biogas

1. What is biogas

Biogas is a fuel gas made from biomass such as feces, food waste, grass and straw etc. during the anaerobic fermentation process. Biogas contains about 55%—70% methane(CH₄), and some carbon dioxide (CO₂), some water vapor (H₂O), some hydrogen, some carbon monoxide(CO)and some Hydrogen sulfide (H₂S). The heat value of biogas is 5142 kcal / m³.

2. Basic conditions needed for biogas production:

- 1) Strict anaerobic environment: Because the bacteria producing methane are particularly sensitive to oxygen and can not survive in aerobic environments, therefore, the construction of an anaerobic digestion reactor (also name as biogas plant) that can provide a strict anaerobic environment is the key to successful biogas production.
- 2) Sufficient inoculums: The methane bacteria needed for anaerobic fermentation comes from anaerobic activated sludge (also called strain). The sludge from running biogas plants, from waster water treatment plants or from sewers all are inoculums. Cow dung is also inoculums.
- 3) Suitable fermentation temperature: The methane bacteria can ferment biomass at the temperature between 8 -65 °C, and the higher the temperature the more active the methane bacteria, and the higher the biogas production.
- 4) Appropriate pH: The methane bacteria like to breed in neutral or slightly



alkaline environment, so the pH value of the liquid in the biogas plant should be controlled between 6.8 and 7.5.

- 5) Suitable carbon-nitrogen ratio: When the carbon-nitrogen ratio of the fermentation materials meet 20-30:1, the anaerobic bacteria will be active, therefore, the biogas production will be fast.

3. The application of Biogas and the residue.

- 1) Biogas with the main component of methane (methane content is about 55-70%) is a low-carbon clean energy and can be directly used as fuel like natural gas or liquefied petroleum gas, it can be used to generate electricity also.
- 2) Biogas residue and biogas slurry are good organic fertilizers, can be used for agriculture.

Part Two: The use and daily maintenance of biogas plant

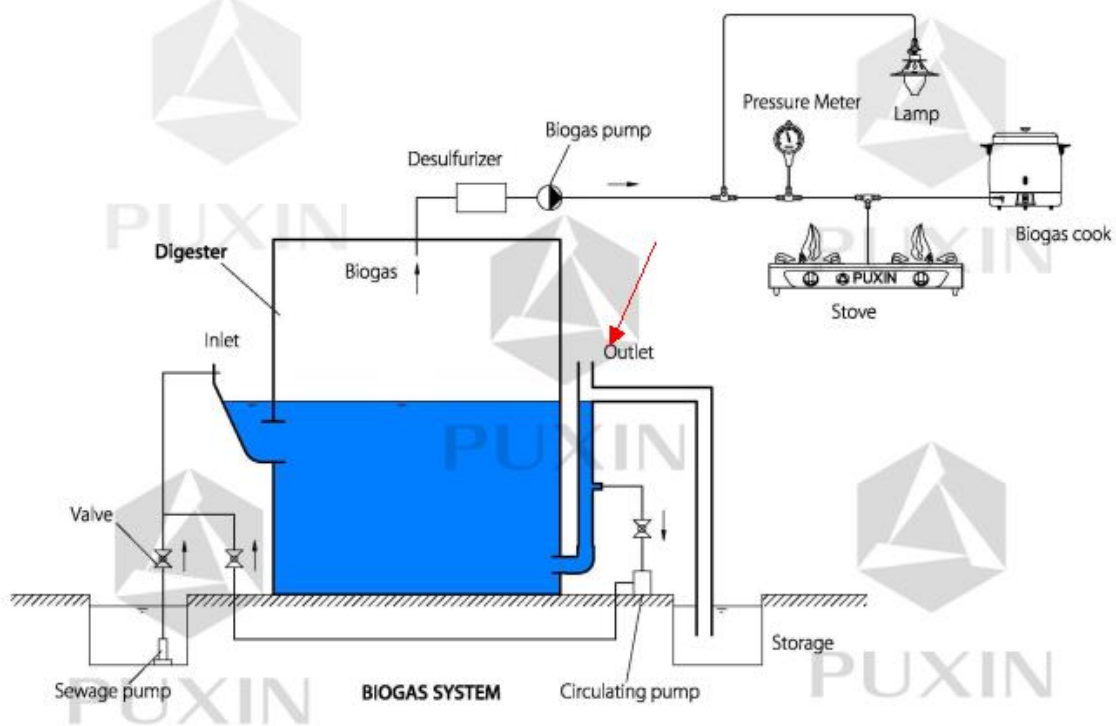
1. The first batch feeding and initial operation of the biogas plant

- 1) The preparation of inoculums: Fresh Cow dung or residue from an operation digester can be used as inoculums. In the first batch feeding for initial operation over 10% (170kgs for a 3.4m³ biogas plant) inoculums should be added into the feeding material. The more the inoculums added the easier the initial operation.
- 2) The first batch feeding: Mix the raw materials with the inoculums and put



them together into the biogas plant. In the first batch feeding for initial operation the concentration should be 4 ~ 6%.

- 3) Seal the biogas plant with water: After the raw materials and the inoculums have been put into the biogas plant, add water into the biogas plant. For PUXIN portable biogas plant the water should be added till the water level over the outlet.





You add water into the biogas plant from the inlet, or use the sewage pump to pump the waste into the plant. The water added into the biogas plant can be domestic wastewater, river water, reservoir water; it also can be well water or tap water, but can't be toxic wastewater. The temperature of the water should be above 20 ° C. In cold winter warm well water is a good choice.

- 4) Igniting test: After the biogas plant has been sealed with water, usually in 3-10 days the biogas plant will produce biogas. At the beginning usually the biogas produced can't be lighted up because the methane content is too low. If the biogas can't be lighted up, you should release all the biogas in the gasholder and recollect the biogas, and repeat this process until the biogas can be lighted up.
- 5) Initial operation adjustments: In the event of acidification (during the event the biogas usually can't be lighted for a long time, or the gas production decreases rapidly, or even completely stops, the color of the liquid becomes yellow.) there are different ways can be used to treat the acidification according to the different levels of acidification.
 - If the pH value is not below 6.0, the biogas plant can adjust its pH value automatically, the pH value will grows up gradually and the gas production will become normal, but the process will takes a relatively long time. Put some more inoculums into the biogas plant may shorten the process.
 - If the pH value is below 6.0, take some liquid out from the biogas plant and put more inoculums into the biogas plant. At the same time add some lime



or plant ash in the biogas plant to adjust the pH value to above 6.0.

- If the pH value has been adjusted to about 7.0 and the biogas plant still do not produce biogas that means the liquid of the biogas plant contains chemicals that can kill the methane bacteria. In this case you should clean the biogas plant and refill it with raw materials and inoculums.
- If the pH value has been adjusted to about 7.0 and the biogas plant works normally but the gas production is very low that means there are gas leakages in the pipe system. In this case you should check the pipe system, find and repair the leakages.
- When the temperature in the biogas plant is below 10°C, the biogas plant will stop gas production. Therefore, in winter the biogas plant should be thermal insulated by covering an insulation layer or a green house on the biogas plant.

2. The daily maintenance of biogas plant

- 1) To keep a constant gas production, after about 30 days from the day when the biogas plant begin to produce biogas normally you should add raw fermentation materials into the biogas plant regularly.
- 2) For a 3.4m³ assembly biogas plant to keep max 2m³/d biogas production, 60kg cow dung or 45kg pig dung or 25kgs food waste is needed daily.
- 3) In the period of normal operation you can increase the concentration of the feeding materials up to 8 ~ 10%. The liquid from the biogas plant can be



recycled.

Part Three: Appendix

1. The data about gas production for different raw materials

1) Relationship between the volume of biogas plant and the livestock keepers

Item	unit	pig	cow	Sheep	Chicken
Daily Feces	kg	3.0	30.0	1.5	0.1
Dry material content	%	18	17	25	30.0
a 6m ³ biogas plant		20	3	50	400
a 8m ³ biogas plant		25	4	60	530
a 10m ³ biogas plant		33	5	70	667

2) Raw material needed to produce 1 cubic meters biogas

Raw material	Water content (%)	Dry material gas production rate (m ³ /kg)	Raw material needed to produce 1 cubic meters biogas(kg)	
			Dry material	Fresh material
Pig Manure	82	0.25	4.00	22.23
cow Manure	83	0.19	5.26	30.96
Chicken Manure	70	0.25	4.00	13.34
Human Manure	80	0.30	3.33	16.67
Rice Straw	15	0.26	3.84	4.53



Wheat Straw	15	0.27	3.70	4.36
Corn stalks	18	0.29	3.45	4.21
Fresh grass	76	0.455	2.20	9.17
Water Hyacinth	93	0.31	3.23	46.15

3) Raw material parameters

Raw material	C%	N%	C:N	Methane content of biogas produced (%)	Gas duration (d)	Dry material content (%)	Dry material biogas production rate (L/.KG)	Raw material biogas production rate (L/.KG)
Dry Wheat Straw	46	0.53	87:1	59		82	425	348
Dry Rice Straw	42	0.63	67:1	61		83	409	340
Corn stalks	40	0.75	53:1	53~59	90	80	412	
Fresh grass	11	0.54	26:1	70	60	24	455	107
Fresh Sheep Manure	16	0.55	29:1					
Fresh cow Manure	7.3	0.29	25:1	50~60	90	17	205	35
Fresh Pig Manure	7.8	0.60	13:1	65	60	18	425	77
Fresh Human Manure	2.5	0.65	2.9:1	50	30	20	426	85
Fresh Horse Manure	10	0.24	24:1	60	90		279	

Part Four: The function of the equipped appliances.

1) **Sewage pump:** Pump the waste into the digester instead of operating manually;

2) **Circulating pump:** Mixing the outlet water and inlet water together, to



make the fresh material and the former material together;

3) **Shredder:** Shred the food waste into slurry for easy and quick fermentation;

4) **Electrical heater:** To heat the digester, improve the biogas fermentation rate in the cool conditions.

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