4th International Conference on
Energy, Environment and Sustainable Development 2016 (EESD 2016)

277. Domestic Fixed Dome biogas Plant Installed at Khaskheli Village Hyderabad Bypass

Najeebullah channa*, Dost Ali Abbasi, Abdul Razaque Sahito

Institute of Environmental Engineering & Management Mehran University of Engineering & Technology Jamshoro,sindh pakistan
E-mail address:anajeeb295@gmail.com

Abstract

Biomass is a very valuable source for renewable energy, it contains the rich quantity of organic and inorganic matters different verity of biomass available for generation energy source such as from buffalo dung, cow dung, agricultural waste and poultry farm wastes from sugar cane (Bagasse) and also pig dung, by using the suitable technology as anaerobic digestion for the generation of biogas for domestic and industrial purpose, Anaerobic digestion is a feasible and easy process for biogas generation and eco-friendly fertilizer, our objective was to construct an on-site fixed dome biogas digester to produce biogas that can be utilized for household cooking activities.
The pilot-scale biogas digester of 4m3 capacity, having an area of (22x14) ft2 was constructed at Khaskheli village near bypass Hyderabad. The location was selected due to the readily abundance of animal dung requirement on daily basis. The feed/water ratio was maintained at 1:1. The digester was then stabilized in 15 days. The results showed generation of biogas is 4m3 which contains the more than 65% of methane.

Keywords: *buffalo dung;anaerobic digestion;eco-friendly;digester;biogas;methane.*

1. Introduction

Energy demand is met mainly through the renewable and non-renewable source of energy but it depends on the availability of source due to rapid population growth and rising in the demand of energy Biogas is cheap and renewable source of energy and has achieved a great importance in the world biogas is a fuel which can be used to contribute this need (Urmeeet al., 2009) Biomass contributes the major role in rural areas of Pakistan to supply the biogas for cooking and heating purpose generally biogas contains the higher quantity of methane that is (55%-75%)Animal manure is available in plentiful quantity especially in rural areas of sindh Pakistan for utilization the animal manure we can generate the biogas and environmental friendly fertilizer for the agriculture activities ,different types of biogas digesters are exist for biogas generation such as floating drum digester and fixed dome digester and balloon type digesters fixed dome type digesters are widely used due to low cost and no maintenance require fixed dome type digesters are more convenient then the floating drum type digesters because of leakages ad corrosion in drum. These digesters were constructed as underground basis covered with clay type soil work as an insulating material fixed dome digester is a copious alternative to treating the animal manure

2. Study Area

Khaskheli village near Highway Hyderabad, is situated on the right bank of River Indus, at geographical position *25.456786° N, 68.365135° E*, situated at an elevation of 20 m this village is surrounded by agriculture. Area elected for digester is 264 ft^2(12 ft. x 22 ft.)Besides the house there is a cattle farm which consist of 20 Buffalo'sand 6 Cows.

Fig.1. Study Area

3. Methodology

3.1 Design

The Fixed Dome Biogas Plant Fixed Dome Biogas is consist of four main parts, these are

- Inlet
- Dome
- Outlet
- composite Pits

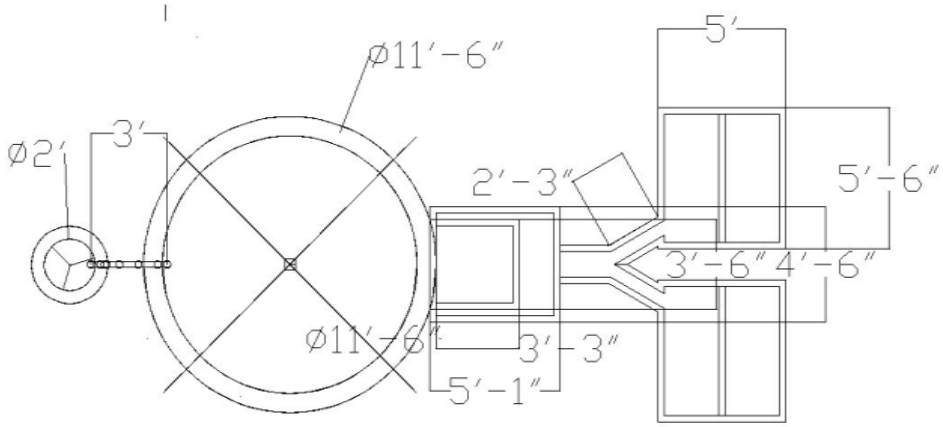

Fig. 2. Design of Biogas plant

3.2 Construction

The Total area of the Fixed Dome biogas Plant is 22 ft in length and 12 ft is its width. The biogas plant is concrete based Plant we started with the construction of Main Digester. The diameter of the Digester is 10 ft. The foundation was placed with cobbles and gravel aggregate and filled with concrete up to 15cm, during the construction on walls of digester which is of 3ft. The inlet pipe is placed above about 1.5 ft from the foundation We started continue to erect wall of Main digester Next stage was the construction of Dome on the main Digester, the Dome is of 10 ft with its width . As Dome is of RCC, we used steel for this purpose 50 kg of steel is used, steel bars tied in a way it forms like a cage on the main digester, and the height of the Digester is 5.4 ft from the foundation. For shattering

Purpose we used an iron net , that was covered from the Inside of the cage that was put on the digester for constructing the Dome , upon that net shattering the filling of concrete was applied .It is important that the concrete mixture should be well compacted , After construction of Dome Curing takes an important part to make Dome structure Robust, Next is the construction of Out let of the Main Digester, the base of digester is higher from the excavation point , it is on the level of digester wall from the walls of outlet is erected After that Compose pits are made , the total length of the

Fig. 3. Construction of Dome

7ft and the width is 5ft, there is wall is erected in between that is of 2.5 ft, to divide the two pits.

The diameter of inlet is 2.5ft. And manually handled mixer device is installed Curing is the back bone of the robust biogas Plant so Maximum Curing should be Applied specially on Dome

3.3 Hydraulic Test

The main reason of hydraulic test is that the Structure is robust in terms of seepage and water leakages. If seepage occurs it indicates the lacking in physical strength, if there is Leakage in structure that makes structure weak by the time. To conduct this test we filled the water that much, the joints of the Dome are in the water. As the water come up in the outlet. When the water is filled marked up the water level in the outlet, my choke or marker etc. Left the Filled water in the Dome for 1 or 2 days after 2 days we have to check either the water level that we marked that day is still there or not, if water is decreased up to 5 to 6 inch, then there is Structural leakage in the dome although we have to focus on the joints.

3.4 Air Leakage Test

To conduct air leakage test is very important to identify the leakage from the dome. For air leakage test we require the compressor, first we connect the gas pipe from outlet of compressor to the point of collection gas pipe from dome. Then we start the compressor air will come to dome there is a gauge at the outlet of compressor and also another gauge is installed at the point of collection of gas pipe for reading of pressure. Then we measure the pressure from the gauge when the both gauges give the same pressure readings we stop the compressor and then we leave the dome for 24 hours. After 24 hours we will check whether the pressure is same or not, only 3 to 5% allows the variation in pressure. If the gauge is not giving the same result or pressure variation is high there must be a leakage from the dome.

3.4 Start Up Of Plant

We can indeed count this phase is very critical phase we are using the buffalo Dung, dilution of buffalo dung with water at ratio of 1:1 is very important if the ratio is disturbed the substrate is more concentrated there may be chances of developing the acidic condition or substrate is more diluted with water then there will less generation of the biogas, selected daily feed for digester is 24 kg of buffalo dung with 24 litters of water is mix with the help of mixer, manual mixer is installed for effective mixing. Initially when we were filling the digester caustic soda (NaOH) has added to control the acidic condition during the retention time. Digester takes 2 to 3 weeks to stable it has been observed that after 15 days

biogas generation reached at optimum condition.

4. Results and Discussion

For analysing the parameters of biogas we conducted different laboratory tests using the standard laboratory methods to finding the stability of digester the tests consists of PH, Alkalinity, Volatile fatty acids (VFA), Moisture content (MC), Total solids (TS), Volatile solids (VS).

Table 1. Results of Biogas Digester

S. No:	Samples Duration	PH	Alkalinity (mg $CaCO_3$/L)	VFA (mg CH_3COOH/L)	VFA/Alkalinity <0.5	M.C%	V.S%	T.S%
01	Week 1	7.0	2500	250	0.1	95.3	71.6	4.7
02	Week 2	7.3	1850	204	0.11	94.4	72.5	5.6
03	Week 3	7.1	800	120	0.15	94	71	6
04	Week 4	7.2	600	24	0.04	93.9	72.8	6.1
05	Week 5	7.3	900	64	0.07	96	68.6	4
06	Week 6	7.5	1400	72	0.05	91.1		8.9

When we fed the dung in the digester initially it has high value of Alkalinity but anaerobic digestion processes starts alkalinity reduces continuously and when methanogenic bacteria start to consume the food alkalinity increases methanogenic bacteria take 3 to 4 weeks to stable the digester and then alkalinity starts increasing.

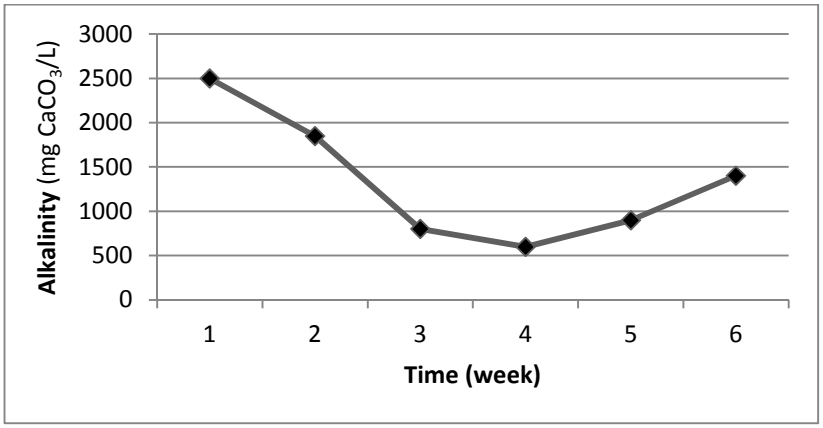

Fig. 4. Alkalinity of the digested substrate

PH value of substrate should be “between” 6.5 to 7.5, when PH value reduces from 6.5 or increase from 7.5 then it effects on the generation of biogas, we have observed digester is stable in the PH value.

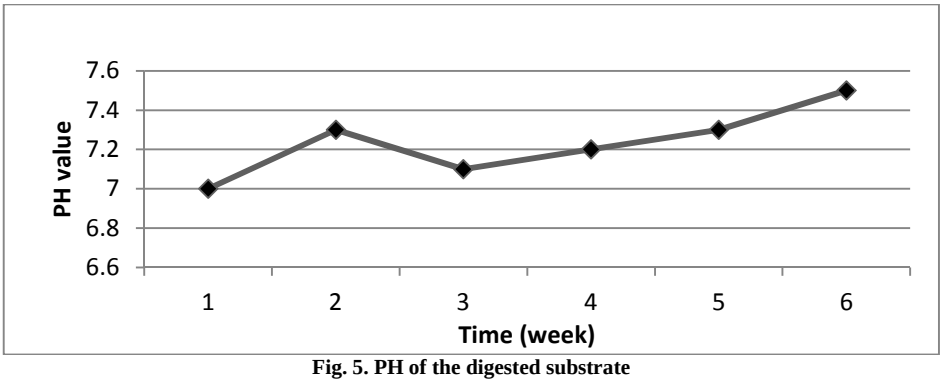

Fig. 5. PH of the digested substrate

It is very important to find the concentration of methane in biogas, sample of biogas is analysed in the Gas chromatography (GC) we observed that biogas contains methane (CH4) 71.18% and carbon dioxide (CO2) 28.81%.

Results - Peak Table

Peak Table | Compound | Group | Calibration Curve

Peak#	Ret.Time	Area	Height	Conc.	Units
1	1.005	281307.2	121000.0	71.18312	
2	1.153	113880.9	19657.3	28.81688	

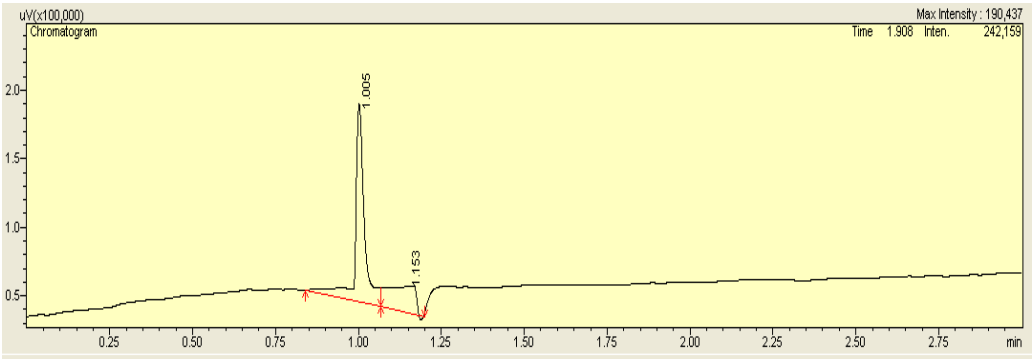

Fig. 6. Results of biogas in (GC)

5. Conclusions

This study reveals that fixed dome biogas plant is feasible choice for treating the animal manure and to get the biogas for domestic use. Fixed dome biogas digester technology is available in affordable amount and it has been improved, during construction of dome care must be taken to reduce the leakages were aroused from dome digester should be close system otherwise fermentation process cannot take place the efficiency of digester depends on the tightness of the digester different methods can be applied to reduce the leakages in the dome such as using the acrylic paint with cement and using the clay layers, and specially interior surface of dome should be plastered.

Acknowledgement

The authors are wishing to acknowledge Mehran University of Engineering & Technology, Jamshoro, Sindh,
Pakistan, for its support to carry out this research work

References

[1] Asif Sajjad, Liaqat Ali Khan, Arif Hamid Makhdum, Asad Imran Sustainable Agriculture Program, Wwf-Pakistan "Social Impacts Of Biogas Plants On Rural Communities Of Sindh, Pakistan" Asian J Agri Biol, 2014, 2(2):80-85.

[2] Syed S.Amjid,Muhammad Q. Bilal, Muhammad S. Nazir, Altaf Hussain Department of Livestock Management, University of Agriculture, Faisalabad, Pakistan "Biogas, renewable energy resource for Pakistan"Renewable and Sustainable Energy Reviews 15 (2011) 2833–2837

[3] Syed Zafar IlyasGroup of Renewable Energy and Environment,Department of Physics, University of Balochistan, Quetta, 87300, Pakistan "A Case Study to Bottle the Biogas in Cylinders as Source ofPower for Rural Industries Development in Pakistan" World Applied Sciences Journal 1 (2): 127-130, 2006

[4] M. Asif ,Glasgow Caledonian University, School of the Built and Natural Environment, Cowcaddens Road, Glasgow G4 0BA, UK "Sustainable energy options for Pakistan" Renewable and Sustainable Energy Reviews 13 (2009) 903–909

[5] Abdul RazaqueSahito, RasoolBux Mahar, And Farooq Ahmed "Effect Of Buffalo Dung To The Water Ratio On Production Of Methane Through Anaerobic Digestion

[6] United States Forces – Afghanistan, Joint Engineer DirectorateKabul, Afghanistan April 2011 Biogas Plant Construction Manual Fixed-dome Digester 4to 20 Cubic Meters