ECOLOGICAL SANITATION SYSTEM FOR AMBARELLI VILLAGE

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ABSTRACT

The present paper deals with the case study of Sanitation system in Ambarelli village, Dholka. The wastewater sanitation system consists of PVC collection pipelines and treatment units. Ecological sanitation system provides the solution to sustainable sanitation as it aims at providing improved sanitation by sanitizing the excreta and re-using it in agriculture. The main objective of this work is to change attitudes of people and encouraging them to consider cleanliness as an important issue and to consider human urine and faeces as a valuable resource and not a waste. The aim of the work is to spread public health awareness and find a local cheap solution for village sanitation services.

Keywords- Biogas, Bio-methanisation , Break-even Analysis , Rate Analysis

I. INTRODUCTION

A safe and sustainable water supply, basic sanitation and good hygiene are fundamental for a healthy productive and dignified life. And yet many of the India's rural people lack access to an improved water supply and proper sanitation facilities. The project deals with the latter problem i.e. a proper environment friendly sanitation system for the rural areas.The site location of the project is village Ambareli, Taluka- Dholkawhich is about 55kms from Ahmedabad.

A preliminary survey of 50 houses was carried out in the village and the result showed that 33 houses have sullage disposal problems.The main problem in the village was improper sanitation facilities for organic waste i.e. human urine and faeces.The project deals with the design of an Ecological Sanitation System which can be useful for a safe and environment friendly sanitation process and it should be economical too. We have suggested and tested an effective solution for the problem which is Fiberglass Reinforced Plastic Biogas Plant.The plant works on the principle of anaerobic bio- methanisation in which waste material(human urine and faeces) mixed with wastewater from the kitchen is fed into the plant through the inlet chamber of the plant. This waste is converted into cooking gas with the help of a special type of anaerobic bacteria. The main component of the gas produced is methane and carbon-dioxide which is a renewable source of energy.

This plant is relatively new compared to precast concrete plants , light-weight, easy to connect with toilets and easy to use. A prototype is made and tested to check its space requirements, efficiency, biogasproduction.The

project also gives a brief information on the rate analysis of a single FRP Biogas plant and the time required for the recovery of invested capital i.e. Break-even point.

II. TOILET LINKED BIO-GAS PLANT

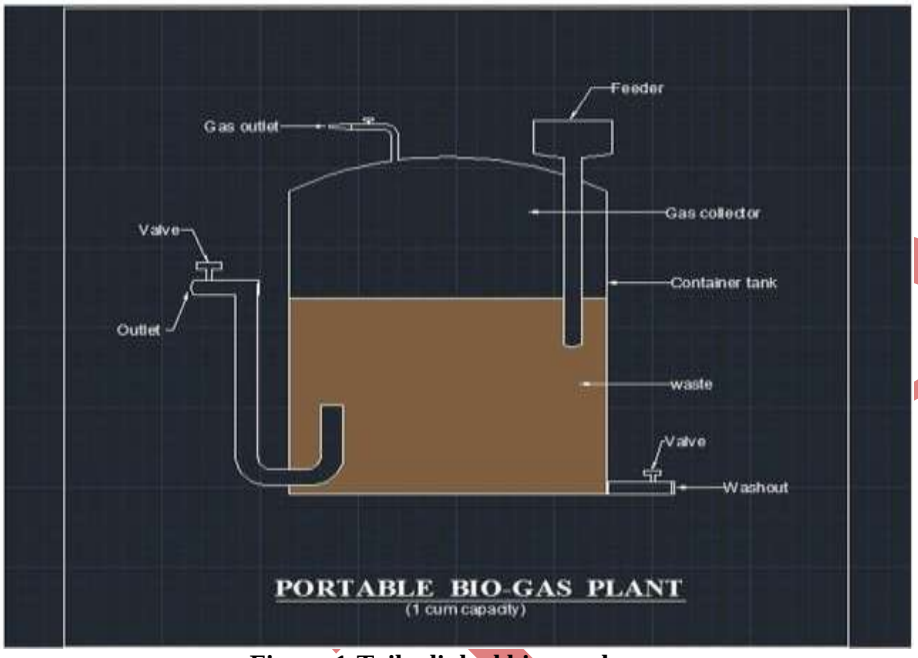
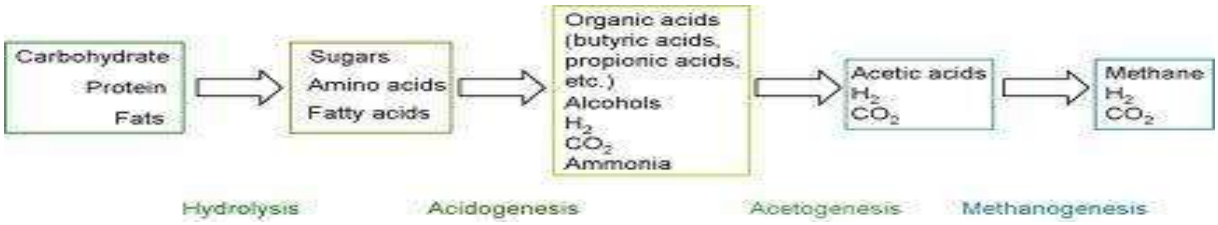


Figure-1:Toilet linked biogas plant

2.1 Operation of the plant

After the plant has been installed, anaerobic bacteria is allowed to grow and multiply within the plant. After a period of two or three days the plant will be in working condition and the production of biogas will commence in full scale. A pipe from the toilet can be attached to the plant. The required facility for this will be provided in the plant. The human waste generated from the toilet and the waste water can be treated in the plant. Separate inlets for depositing these wastes are available in the plant. The process of anaerobic bio-methanation takes place in the tank. The bio waste and the human excreta that reach inside the plant will be decomposed by the work of the bacteria and transformed into biogas and bio manure. The biogas produced is collected in the gas chamber of the plant. This gas are methane and carbon-dioxide and can be taken as fuel for cooking purposes by connecting the gas to the stove in the kitchen using separate pipe line. A separate valve is provided at the bottom of the plant for yearly cleaning purpose.



Fiure-2:Bio-Methanation of Organic Materials

III. PROTOTYPE AND ITS TESTING

Figure-3:FRP Biogas Plant

3.1Space requirements and time of installment

The space required for a domestic plant (1 Cum) is one cubic meter. Time required for the installation is 1- 4 hours, depending upon the model of the plant. The gas generated from the waste of a family of 3 -5 members is sufficient enough to work a single burner stove for more than 2 hrseveryday. The return on investment of a domestic bio waste treatment – bio energy plant is also very good. A 1 Cum plant is sufficient to save the 70% - 90% consumption of fire wood or other cooking fuels every day.

3.2Experiment & its Results

An Experiment was carried out to check the production ofbiogas from a prototype plant of 200litres. Human urine, Faeces and kitchen waste was used as the organic material. The results are then computed for a plant of volume 1000litres and given below.

Volume of Digester	:1000 Litres
Suitable for	: 3 -5 member family
Space required for the installation	: 1. 25 SqMtrs.

Gas generation per day : 1 Cum Biogas

1 Cum Biogas : 0.5 Kg. LPG(approx.)

3.3Selection of the Size of the Plant

It is sufficient to have a treatment plant of 2 Cum size, for treating human waste and bio waste generated in a household having a family comprising up to a total of five members. The most important point to be taken note of while operating a plant is, to regulate the quantity of waste to be fed into the plant, strictly in accordance with the optimum treatment capacity per day. If, however, the plant is overfed by the deposit of more quantity of waste, the working efficiency of the plant will gradually become deteriorated. In such situations the gas produced from such plants may not be ignited, and in some cases stink odour may also come out from the plant in a large measure. Even if the quantity of waste fed into the plant is a little less than the prescribed limit, or the plant is not fed at all for a few days the working of the plant will not be not affected.

Sr. no.	Size (CUM)	Suitable for family members	Production of gas per day in CUM
1	1	1 to 5	1
2	2	5 to 7	2
3	3	7 to 10	3
4	4	10 to 15	4
5	6	15 to 20	6

Table-1:Size of Biogas Plant

IV.RATE ANALYSIS

S.No.	Particulars Materials	Quantity/ Number	Rate (Rs.)	Per	Amount (Rs.)
1	Tank (200 litre)	200	4	litre	800
2	Tank connection	1	40	item	40
3	Bend G.I.	1	25	item	25
4	Handle valve	1	180	item	180
5	Nozzle	1	40	item	40
6	Eflon tape	1	30	item	30
7	G.I. elbow	1	180	item	180
8	Eptfe(M) UPVC	1	80	item	80
9	Eptfe(F) UPVC	1	30	item	30
10	Hole tight	1	20	item	20
11	UPVC valve (1.5 inch)	1	637	item	637
12	UPVC pipe	5	50	feet	250
13	UPVC tank connection(1 inch)	1	70	item	70
14	UPVC valve (1 inch)	1	110	item	110
15	UPVC Eptfe(1 inch)	2	18	item	36
16	Solution UPVC	1	20	item	20
17	UPVC tank connection(1.5 inch)	1	220	item	220
18	Saw Blade	1	18	item	18
19	Funnel	1	15	item	15
	Total				**2801**
	Labour				
1	Plumber	1	400	day	400
	Total(materials + Labour)				**3201**

Table-2-Rate Analysis of a single FRP Biogas

Tank Capacity = 200 litres

Rate= 3201/200= Rs.16/litre

Cost of 1 CUM biogas plant= 1000 X 16 = Rs.16000

V. BREAK-EVEN ANALYSIS

Break-even(orbreak even) is the point of balance between making either a profit or a loss.

5.1 Break-even analysis of 1 cum. Toilet linked biogas plant

Cost of 1cum biogas plant = Rs. 16000

Unit price of LPG(Per kg) = Rs. 30

Therefore ,

break – even point = 16,000/30 = 533.3 kg

1cum biogas = 0.5 kg LPG

No. of years to reach break – even point =533.3 / (0.5*365) = 2.92 years

Table-3:Break-even analysis table for all the 50 houses.

No. 1	Occupants (2)	(CUM) 3	Production (cum/day) 4	t LPG (kg/day) (5)=(4)/2	plant(Rs) Production (cum/day) (6)	LPG (Rs/kg) (7)	Point (8)=(6)/(7)	(9)=(8)/(5)*365
1	4	1	1	0.5	16000	30	533.3	2.92
2	3	1	1	0.5	16000	30	533.3	2.92
3	6	2	2	1	32000	30	1066.6	2.92
4	5	1	1	0.5	16000	30	533.3	2.92
5	5	1	1	0.5	16000	30	533.3	2.92
6	6	2	2	1	32000	30	1066.6	2.92
7	7	2	2	1	32000	30	1066.6	2.92
8	6	2	2	1	32000	30	1066.6	2.92
9	6	2	2	1	32000	30	1066.6	2.92
10	2	1	1	0.5	16000	30	533.3	2.92
11	3	1	1	0.5	16000	30	533.3	2.92
12	3	1	1	0.5	16000	30	533.3	2.92
13	3	1	1	0.5	16000	30	533.3	2.92
14	6	2	2	1	32000	30	1066.6	2.92
15	6	2	2	1	32000	30	1066.6	2.92
16	7	2	2	1	32000	30	1066.6	2.92
17	7	2	2	1	32000	30	1066.6	2.92
18	6	2	2	1	32000	30	1066.6	2.92
19	4	1	1	0.5	16000	30	533.3	2.92
20	19	6	6	3	96000	30	3200	2.92
21	6	2	2	1	32000	30	1066.6	2.92
22	6	2	2	1	32000	30	1066.6	2.92
23	10	4	4	2	64000	30	2133.3	2.92
24	11	4	4	2	64000	30	2133.3	2.92
25	3	1	1	0.5	16000	30	533.3	2.92
26	6	2	2	1	32000	30	1066.6	2.92
27	6	2	2	1	32000	30	1066.6	2.92
28	5	1	1	0.5	16000	30	533.3	2.92
29	6	2	2	1	32000	30	1066.6	2.92
30	4	1	1	0.5	16000	30	533.3	2.92

31	5	1	1	0.5	16000	30	533.3	2.92
32	5	1	1	0.5	16000	30	533.3	2.92
33	2	1	1	0.5	16000	30	533.3	2.92
34	5	1	1	0.5	16000	30	533.3	2.92
35	5	1	1	0.5	16000	30	533.3	2.92
36	5	1	1	0.5	16000	30	533.3	2.92
37	6	2	2	1	32000	30	1066.6	2.92
38	3	1	1	0.5	16000	30	533.3	2.92
39	5	1	1	0.5	16000	30	533.3	2.92
40	5	1	1	0.5	16000	30	533.3	2.92
41	7	2	2	1	32000	30	1066.6	2.92
42	3	1	1	0.5	16000	30	533.3	2.92
43	10	4	4	2	64000	30	2133.3	2.92
44	7	2	2	1	32000	30	1066.6	2.92
45	6	2	2	1	32000	30	1066.6	2.92
46	4	1	1	0.5	16000	30	533.3	2.92
47	4	1	1	0.5	16000	30	533.3	2.92
48	8	3	3	1.5	48000	30	1600	2.92
49	5	1	1	0.5	16000	30	533.3	2.92
50	7	2	2	1	32000	30	1066.6	2.92

VI. CONCLUSION

[1] From the experiment we can conclude that the space required for the FRP biogas plant of 1000litre is around 1.25m^2 much less than a bigger biogas plant whose area requirement is around 1000m^2.

[2] The waste used is human urine, faeces and kitchen waste which is easily available and as the plant is air-tight no odour problem is caused.

[3] The efficiency of the plant is high generally 70-90% because the size of plant is small in comparison to larger plants whose efficiency is generally about 50%.

[4] The plant can also be used by 2 houses(2cum plant) as it requires very less space and the installation period is 1-4hours and it will start working in around 2-3 days.

[5] The biogas generated by a 1000litre plant is around 0.5kg LPG which is sufficient enough to work a single burner stove for more than 2 hours everyday.

[6] By rate analysis of a 200litre plant we conclude that the whole cost of the plant is Rs.3201 i.e Rs16/litre. So the cost of 1000litre plant = Rs 16000.

[7] The Break-even analysis shows us that the break-even point=533.33kg and the invested capital can be recovered in 2.92years or around 3 years.

VII. REFERENCE

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[2] Special thanks to Prof. A.M. Malek ,Head Of civil department, of L.D. College of Engineering for giving extreme support on the topic.

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